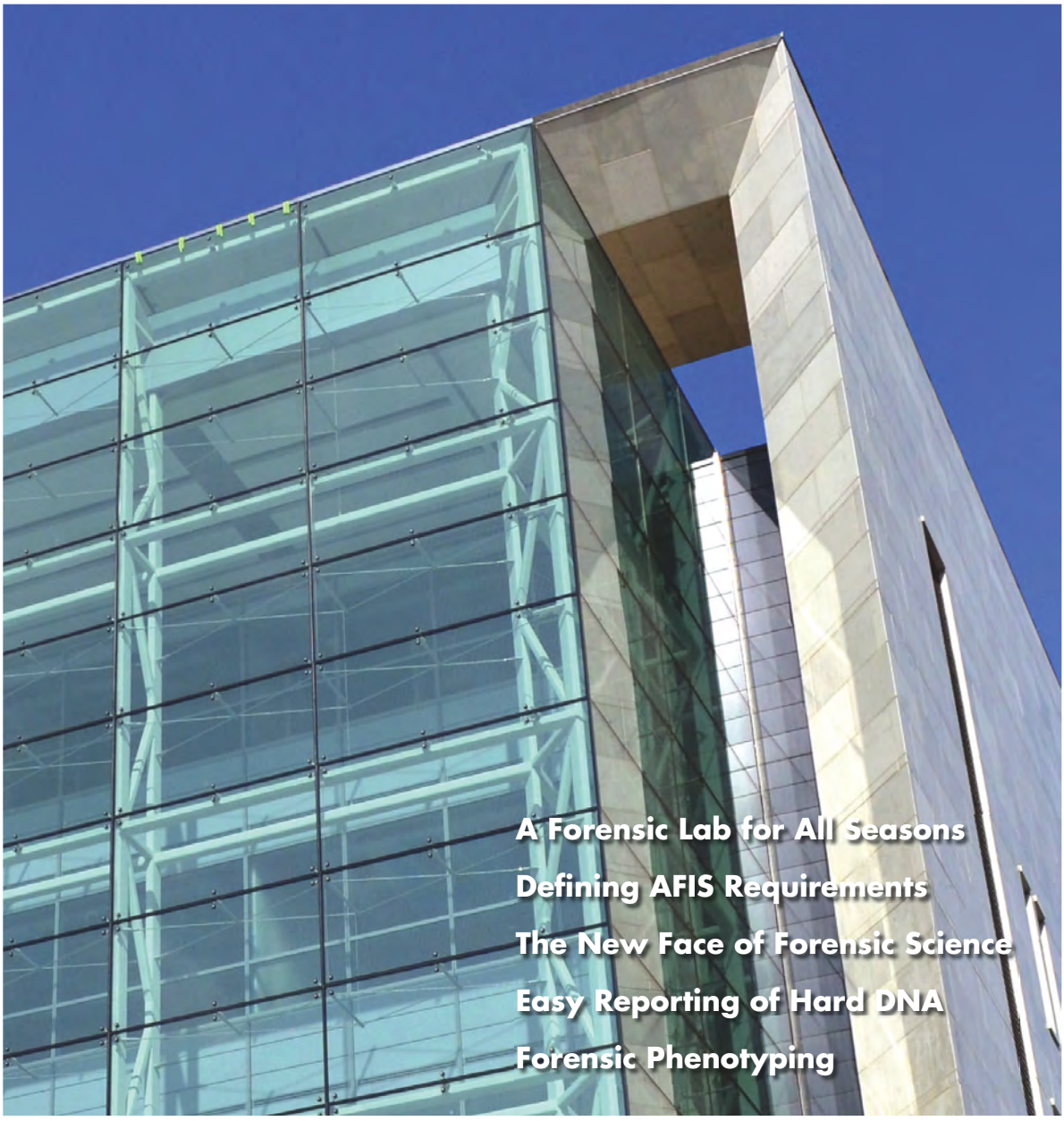
Forensic® MAGAZINE

technology, trends, products, and solutions for forensic professionals

Vol.9|No.4 AUGUST|SEPTEMBER 2012



A Forensic Lab for All Seasons

Defining AFIS Requirements

The New Face of Forensic Science

Easy Reporting of Hard DNA

Forensic Phenotyping

VICON Business Media, Inc
A Subsidiary of Advantage Media, LLC

www.forensicmag.com

Advance Your Career While Still Doing The Job You Really Love

UF UNIVERSITY of FLORIDA

Earn a Master's Degree in Forensic Science ONLINE

Graduate Degrees

- MS in Forensic Science
- MS in Forensic Toxicology
- MS in Drug Chemistry
- MS in Forensic DNA & Serology
- PSM in Forensic Science

Certificate Programs

- Environmental Forensics
- Forensic Death Investigation
- Drug Chemistry
- Forensic DNA & Serology
- Veterinary Forensic Sciences

Popular Electives

- Weapons of Mass Destruction
- Blood Distribution and Spatter
- Environmental Forensics

Our classes are taught by internationally recognized faculty with world-class expertise. Join the more than 750 students from 40 countries who have completed our online graduate forensic science program, and the more than 300,000 UF alumni worldwide. You can network in our online forum with like-minded professionals around the world who are also enrolled, or who have been enrolled in the past.

UF is the fourth largest academic institution in the United States and is accredited by the Southern Association of Colleges and Schools and the Association of American Universities.

For more information, visit: www.ForensicScience.ufl.edu

UF UNIVERSITY of FLORIDA

Outstanding LEADERSHIP 2010 Award Winner
United States Distance Learning Association

2006 ADEC Award for Excellence

WORLD CLASS

Call: (352) 278-8588 Email: forensicscience@cop.ufl.edu P.O. Box 100484 Gainseville, FL 32611-0484

SAME TRUSTED UFED NOW 10X FASTER

Introducing the Cellebrite UFED Touch: The NEW Industry Standard in Mobile Forensics

Faster: New processor and memory can take hours off an examination. Easier to use: A touch screen simplifies data extraction. More portable: an integrated battery and external hard drive* optimize UFED for the field. The new UFED offers more powerful data extraction with one-touch simplicity.

Still with UFED's most reliable features:

- Unrivaled device support for all major wireless makes and models, including BlackBerry®, iOS and Android smartphones, GPS devices, and tablets
- Complete extraction and decoding of existing, deleted and hidden data
- Proprietary hardware, software and bootloaders that ensure a forensically sound investigation—every time

Learn more at:
www.ufedseries.com/forensicmag

* External hard drive included with Ruggedized versions only

1.888.853.0030
forensicsales@cellebriteusa.com
www.facebook.com/CellebriteUFED
@CellebriteUSA

cellebrite
delivering mobile expertise

UFED series

AT THE SCENE. IN THE LAB.

WWW.THEEVIDENCECONFERENCE.COM

Get a handle on the evidence you collect

features

6 FROM THE EDITOR
Keeping Up with the Ever-Changing Forensic Landscape
Rebecca Waters

8 THE DNA CONNECTION
Changes
Chris Asplen

10 A FORENSIC LAB FOR ALL SEASONS
Tim Studt

18 DEFINING AFIS REQUIREMENTS
Bob Beall

26 THE NEW FACE OF FORENSIC SCIENCE
Susan Halla and Keith Whittle

32 EASY REPORTING OF HARD DNA: COMPUTER COMFORT IN THE COURTROOM
Dr. Mark W. Perlin

39 FORENSIC PHENOTYPING: THE 21ST CENTURY COMPOSITE SKETCH
Tim Kupferschmid

42 THE SAFETY GUYS
Lucy in the Lab with Diamonds
Vince McLeod, CIH

44 DIGITAL FORENSIC INSIDER
Windows 7 Registry Forensics: Part 6
John J. Barbara

46 WHO SAYS YOU CAN'T DO THAT
Arson: Crime Scene Processing Basics
Dick Warrington

departments

38 How it Works **45** Advertiser Index

Forensic Magazine® (ISSN #1553-6262, USPS #023-655), is a registered trademark of and published bi-monthly by Vicon Business Media, Inc. a subsidiary of Advantage Business Media, PO Box 779, Amherst, NH 03031. All rights reserved under the U.S.A., International, and Pan-American Copyright Conventions. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, mechanical, photocopying, electronic recording or otherwise, without the prior written permission of the publisher. Opinions expressed in articles are those of the authors and do not necessarily reflect those of Vicon Business Media Inc. or the Editorial Board.

Periodicals Mail postage paid at Rockaway, NJ 07866 and at additional mailing offices. **POSTMASTER:** Send return address changes to Forensic Magazine, P.O. Box 3574, Northbrook, IL 60065. Publication Mail Agreement No. 41336030. Return undeliverable Canadian addresses to: Imex/Pitney Bowes, P.O. Box 1632, Windsor Ontario N9A 7C9.

Subscription Inquiries/Change of Address: contact: Omeda Customer Service, P.O. Box 3574, Northbrook, IL 60065-3574, Phone: 847-559-7560, Fax: 847-291-4816, email: abfor@omeda.com. Change of address notices should include old as well as new address. If possible attach address label from recent issue. Allow 8 to 10 weeks for address change to become effective. Subscriptions are free to qualified individuals. Subscription rates per year are $120 for U.S.A., and $180 for Canada, Mexico & foreign air delivery, single copy $15 for U.S.A., $20 for other locations, prepaid in U.S.A. funds drawn on a U.S.A. branch bank.

Notice to Subscribers: We permit reputable companies to send announcements of their products or services to our subscribers. Requests for this privilege are examined with great care to be sure they will be of interest to our readers. If you prefer not to receive such mailings, and want your name in our files only for receiving the magazine, please write us, enclosing your current address mailing label. Please address your request to Omeda Customer Service, P.O. Box 3574, Northbrook, IL 60065-3574.

Printed in USA: Vicon Business Media, Inc. does not assume and hereby disclaims any liability to any person for any loss or damage caused by errors or omissions in the material contained herein, regardless of whether such errors result from negligence, accident or any other cause whatsoever. The editors make every reasonable effort to verify the information published, but Vicon Business Media Inc. assumes no responsibility for the validity of any manufacturers' claims or statements in items reported. Copyright ©2012 Vicon Business Media Inc. All rights reserved.

LUMOS

FT-IR microscopy made easy

- Stand-alone FT-IR microscope with full automation
- Simple easy-to-use interface
- Motorized ATR crystal
- Automated measurements in transmission, reflection and ATR
- Comprehensive validation with 21 CFR part 11
- 10 year warranty on laser & interferometer
- 5 year warranty on IR source

Bruker's new LUMOS is a fully automated FT-IR microscope with an integrated FT-IR spectrometer. LUMOS is designed to combine highest quality in visible inspection and highest performance in infrared spectral analysis. With motorization and networking of all moveable components, the LUMOS provides an ease of use never before seen in FT-IR microscopy.

Contact us for more details: www.brukeroptics.com • www.lumos-ir.com

Bruker Optics Inc.

Billerica, MA · USA
Phone +1 (978) 439-9899
Fax +1 (978) 663-9177
E-Mail: info@brukeroptics.com
www.brukeroptics.com

FT-IR

Innovation with Integrity

from the
editor

Keeping Up with the Ever-Changing Forensic Landscape

Anyone who's been reading our *Forensic News Daily* electronic newsletter can tell you that we're facing constant changes in forensics. The New Mexico Court of Appeals decision in *State v. Gonzales* has once again redefined the application of the confrontation clause; new types of designer drugs are flooding the toxicology scene; and advancements in DNA technology (including Rapid DNA and small sample analysis techniques) are changing the dynamic of what types of samples can be processed and where.

With each issue of *Forensic Magazine* we try to address some of these issues bringing you insight into the changes coming your way. In this issue Tim Kupferschmid explores the potential of forensic phenotyping to develop a physical description of a suspect from a mere DNA sample. While this technology may be a few years in coming, the Rapid DNA technologies Chris Asplen discusses in "The DNA Connection" are already looming.

Our two articles on new crime lab projects highlight the move toward sustainable, scalable, and even more welcoming forensic facilities. Budget restrictions may actually be a catalyst for progress in facility design with city planners and facility designers looking for ways to maximize space while reducing resource requirements (and therefore costs). Our insight into Washington D.C.'s Consolidated Forensic Laboratory is a prelude to an even closer look provided at The Evidence Conference to be held October 1–2, 2012, where we offer a facility tour to attendees.

The Evidence Conference will also feature talks from some of our most popular columnists and frequent contributors on the topics that matter to you. Thanks to your excellent survey feedback, we've been able to put together an impressive agenda covering the most pressing issues in the crime lab, crime scene, and digital forensics. Check out the agenda on the conference Web site: www.theevidenceconference.com.

Forensic Magazine is much more than just a print product delivered to your office every other month, it is a community. As such, I encourage you to become involved in our community. Post your comments, interesting news items, and suggestions on our LinkedIn page, or e-mail me with your topic suggestions, article ideas, and thoughts (rwaters@forensicmag.com). I'm always on the lookout for new ways to help you stay on top of the ever-changing forensic landscape! ***-RW***

Forensic MAGAZINE

Liz Vickers
Group Publisher
631-241-6161
liz.vickers@advantagemedia.com

Tim Studt
Editorial Director
973-920-7748
tim.studt@advantagemedia.com

EDITORIAL
Rebecca Waters
Editor-in-Chief
rwaters@forensicmag.com

Elizabeth Doughman
Editor
973-920-7662
elizabeth.doughman@viconmedia.com

EDITORIAL ADVISORY BOARD
John J. Barbara Digital Forensics Consulting, LLC
Lisa M. Calandro Applied Biosystems
Peter Massey Henry C. Lee Institute of Forensic Science University of New Haven
Kenneth C. Mohr, Jr. Crime Lab Design
Robert S. McLaren Promega Corporation
Anthony J. Tambasco Mansfield Police Laboratory

ART AND PRODUCTION
Eileen Whitmore
Art Director
eileen.whitmore@advantagemedia.com

Chris DeCellio
Production Manager
973-920-7159
chris.decellio@advantagemedia.com

ADVERTISING SALES
Eric Basta
Sales Manager
973-920-7656
ebasta@forensicmag.com

Patty Grogis
Sales Manager
973-920-7658
pgrogis@forensicmag.com

REPRINTS/EPRINTS
For reprints and permissions, contact The YGS Group (800) 501-9571 or ViconReprints@theYGSgroup.com

CUSTOMER SERVICE
ABFOR@Omeda.com • 847-559-7560 • FAX 847-291-4816 • New subscriptions, renewals, changes of address, back isues, and all customer service questions

VICON BUSINESS MEDIA, INC.
a subsidiary of Advantage Business Media
199 Route 101, Bldg #7,
PO Box 779 • Amherst, NH 03031
Phone 973-920-7000 Fax: 603-672-3028

EXECUTIVE OFFICE
ADVANTAGE BUSINESS MEDIA
100 Enterprise Drive, Suite 600
Rockaway, NJ 07866-0912
Phone: 973-920-7000 • Fax: 973-920-7541

Rich Reiff
CEO

George Fox
President

Terry Freeburg
Chief Financial Officer

Susanne Foulds
Vice President/Human Resources

FUMEGARD

Metal Free Polypropylene Fume Hoods

NuAire® FumeGard™ Polypropylene Fume Hoods provide a long lasting rust free environment for product and personnel protection for chemical research, microelectronics, semi-conductor design/development, production assembly processes, and more. Models include Conventional, By-Pass, and Vertical Laminar Flow Fume Hoods.

Durable Polypropylene Construction

NuAire® polypropylene Fume Hoods are constructed from stress-relieved, fully seam-welded, and reinforced white polypropylene for a long lasting, rust free product life.

Virtually Metal Free

All FumeGard™ cabinets are virtually metal free and do not use nylon components. "Double Wall" construction forms the plumbing chase for the routing and connection of all services required. This compartment is constantly under negative pressure to minimize any fume build up. Access panels are provided for front maintenance of HEPA filters, services, electronics system, and view screen counterweight balance system. Hinges, handles, screws, bolts, sinks, and miscellaneous items are also constructed of polypropylene.

Designed to Capture, Contain, and Exhaust

NuAire's HEPEX™ Zero Leak Airflow System maintains quiet uniform airflow. The HEPEX™ System also prevents uneven particulate loading by eliminating direct blower blasts to the HEPA filter and dispensing air over 100% of the HEPA filter surface.

All Fume Hoods are factory tested to meet and exceed SEFA-1-2006 and ASHRAE 110-1995 Standards for Fume Hoods.

NuAire manufactures at three separate locations in Minnesota to create a true made in America product sold in over 150 countries worldwide.

NUAIRE®

/nuaire @nuaire /nuaire /nuaire

2100 Fernbrook Lane | Plymouth, MN 55447 | U.S.A. | 763.553.1270 | WWW.NUAIRE.COM

Chris Asplen

Changes

Every now and then it seems that there are markers in the historical timeline of our continuing efforts to drive the utilization of DNA technology toward its ultimate capacity to solve and ultimately prevent crime. One of those markers is the fact that, while still in its infancy, the quickly emerging "Rapid DNA Testing" community has developed to the extent that it is in need of its own "organization" or "trade association" if you will. Established to promote the development of standards, provide public awareness and education, and advocate for judicial, legislative, and policy acceptance of rapid DNA testing, the Global Alliance for Rapid DNA Testing is a sign of how far the broader scientific DNA community has come.

Ten years ago, Sarah Hart, then Director of the National Institute of Justice, testified before the Subcommittee on Crime and Drugs for the U.S. Senate and provided a vision of the future. She said, "The forensic DNA research and development program is focused on innovations to make DNA faster, more sensitive (in order to more uniquely identify the source of evidence from very small samples), and less costly. One project, currently in the prototype stage and ready to be evaluated by crime lab practitioners, is a DNA chip being developed at MIT's Whitehead Institute. Using exactly the same analytical methods in use today, the Whitehead Chip permits significant miniaturization over today's instruments, allowing analyses to be speeded up from hours to minutes, alleviating overcrowding in already severely constrained public laboratory space, and leading to portability in the future." Several years prior to that, there was even a cover story in *Popular Science* magazine touting the emergence and virtues of "lab on a chip." (To be clear, while I have never shied away from participation in published articles, I wasn't convinced *Popular Science* was where we wanted to be having these discussions. You didn't find me adding my opinion in that article.)

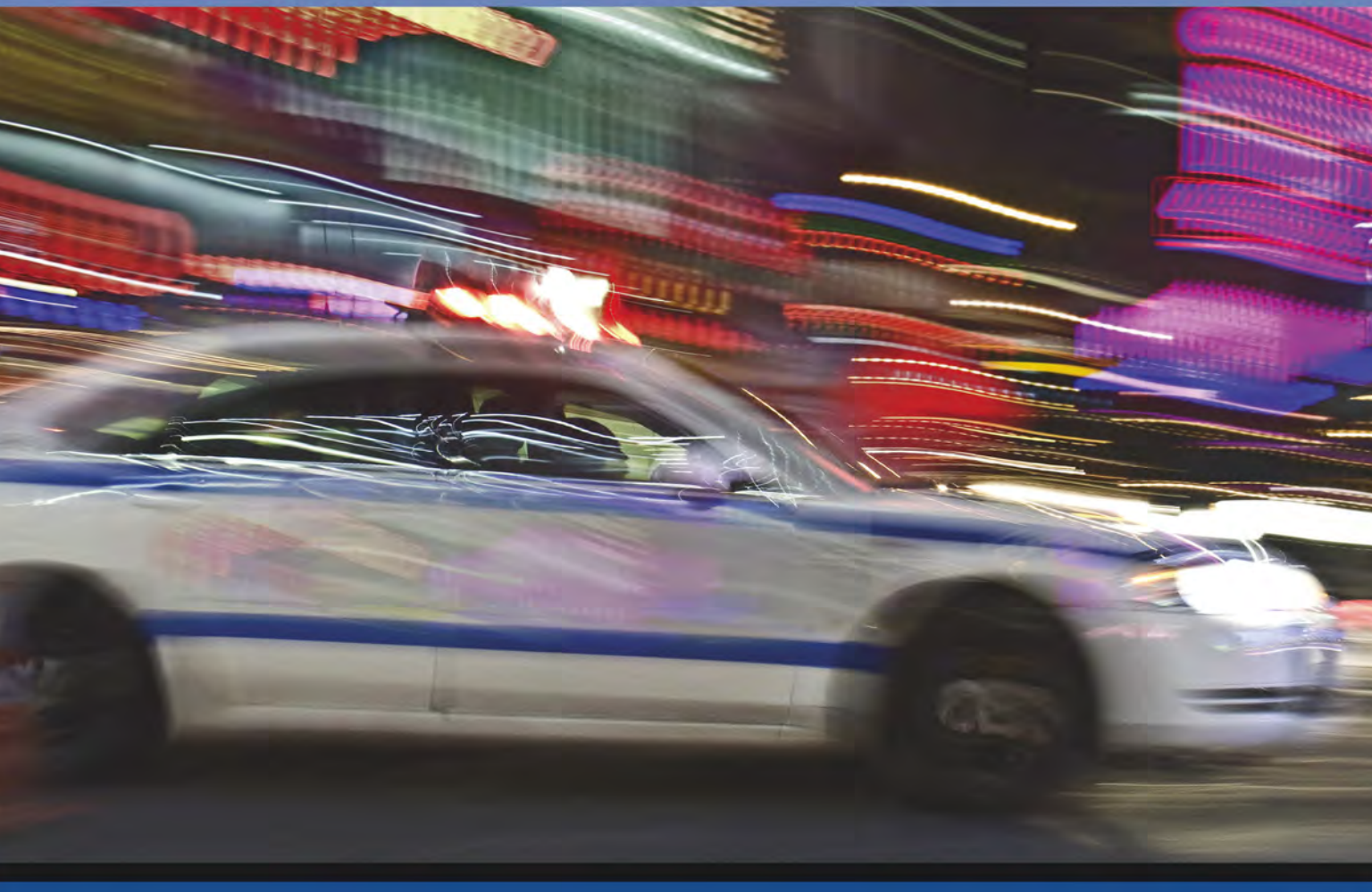
But from those original visions of a smaller, faster, more portable approach to DNA analysis, in appropriate situations and contexts, a number of new players have been brought into the forensic DNA community. Entirely new companies have been created. Players in other forensic fields have decided that DNA analysis should now be part of their portfolio. Industry leaders have tacked their sails to accommodate the changing dynamics that rapid DNA analysis will bring. Software companies see potential markets where none existed before. Consumables makers see new opportunities beyond chemistries to component parts like cartridges. Service laboratories, public and private will have to figure out what this new dynamic will mean and how to best integrate the new technologies into their systems and business models. Even policy wonks like yours truly have new things to think, write, and sometimes argue about. Full Disclosure: the author has been appointed Executive Director of the Alliance.

Industry leaders have tacked their sails to accommodate the changing dynamics that rapid DNA analysis will bring.

As a community, those who have defined their mission as maximizing the potential of DNA technology have driven the integration of DNA into criminal justice systems around the world with a steady and always scientifically-based hand. Regardless of the commercial opportunities or law enforcement's enthusiasm, scientists have ensured that DNA testing—so critical to identifying criminals and preventing future crimes—has moved steadily forward, absent the dreaded two steps back. The vision for the Alliance is that that steady, community-based approach will continue to ensure that DNA analysis, even in this new context of "rapid" testing will remain the gold standard for forensic science.

***Chris Asplen** is President of Asplen and Associates, LLC. He consults with local, state, federal, and international governments on the use of forensic DNA technology. He can be reached at chrisasplen@gmail.com.*

Allow DNA to Drive Your Investigation



Same-Day DNA Service–Only From Bode Technology

Use DNA as A Crime Fighting Tool

- **DNA results in ONE day**
- **Quickly identify leads**
- **Attorneys can have full, court-ready forensic reports the same day***
- **Crime labs can expand capacity during high-profile or rush investigations**

www.bodetech.com/samedaydna

***Contact us for details:**
1.866.263.3443 or +1.703.646.9740
bode.service@bodetech.com

Bode Technology™

A Forensic Lab for All Seasons

Washington, D.C., has put all its forensic tools in one basket—the Consolidated Forensic Laboratory—to create faster, more efficient service to the District.

Tim Studt

The new Consolidated Forensic Laboratory (CFL) in Washington, D.C., looks to become a model in forensic laboratory design and planning. Combining the Metropolitan Police Department's (MPD's) forensics labs with the D.C. Public Health Laboratory and the Office of the Chief Medical Examiner (OCME), the CFL creates a unique multiuser facility for the District. "Not only are there operational advantages to having these different forensics organizations co-located in the same facility, but there are additional work-flow advantages," says Tim O'Connell, project architect at HOK, Washington, D.C. "These groups could all be working on one case together and having them all in the same building is exceptionally valuable and could make their processes very efficient."

Figure 1: The CFL. All images courtesy of HOK.

Sustainable by Design

The CFL is unique in a number of aspects including overall sustainability, forensic diversity, design functionality, and operational efficiency. HOK was contracted by the District to create a LEED (the U.S. Green Building Council's Leadership in Energy and Environmental Design criteria for construction sustainability) Silver building, but the administration had a strong desire to be even more sustainable. "So the building is actually LEED Gold and it's only three points away from LEED Platinum," says O'Connell. "We exceeded everyone's expectations, and we're very proud of that."

Because of the urban context, HOK designers were able to get almost all of the site credits from a LEED point of view. There's public transportation nearby—a DC Metro stop is just two blocks away. "There are lots of DC initiatives including fleet shares and car sharing that allowed us to reduce the overall parking space," says O'Connell. "The district heavily supports all their employees commuting by public transportation."

One of the unique designs that they didn't get any credits for was the negative storm water runoff. The building has a green roof that was designed for both storm water management and energy savings. All the storm water runoff from the hardscape is collected on site and goes into a cistern. That cistern in turn feeds the cooling tower makeup water with the hope that it will save about 2 million gallons of water per year, resulting in direct money savings. This is a cost effective technique as unreclaimed storm water needs to be extensively treated, generating maintenance issues and their severe cost implications. The negative runoff is created with LIDs (low impact design) tree pits. Some of the tree pits on the E Street side of the CFL actually act like bio-soils, little bio-retention ponds that take storm water runoff from the street and

GE Healthcare
Life Sciences

Punch, retrieve, dispense, all in less than 1.5 seconds.

Blink and you'll miss it.

The e-Core™ punch is the only handheld electronic coring and dispensing instrument validated for the forensic market*. Its razor-sharp tip cleanly and precisely punches discs from Whatman™ FTA™ cards. e-Core instrument's ergonomic design enables you to punch hundreds of samples per day without discomfort.

To sign up for a test punch visit www.gelifesciences.com/forecore

imagination at work

*Based on Intellectual Property and developmental validation search.

GE, imagination at work and GE monogram are trademarks of General Electric Company.
FTA, e-Core and Whatman are trademarks of GE Healthcare companies.
© 2012 General Electric Company – All rights reserved.
GE Healthcare Bio-Sciences Corp., 800 Centennial Ave., Piscataway, NJ 08855, USA

04/2012

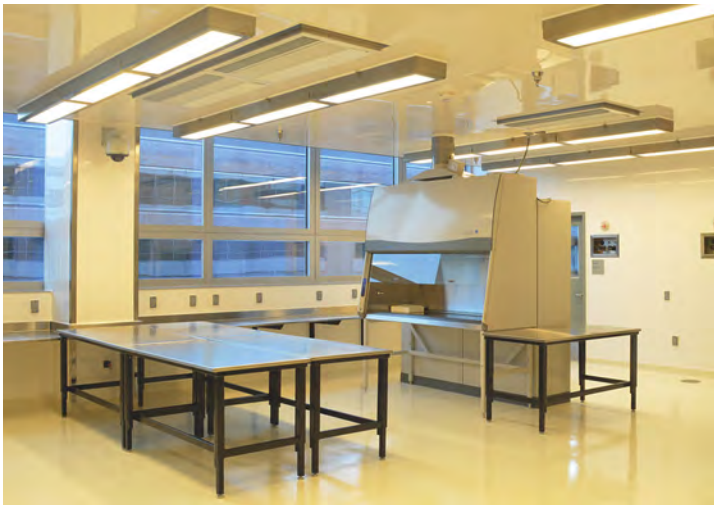


Figure 2: Lab spaces were left open with room to grow.

collect it in an effort to recharge the watershed, hence the negative runoff effect.

There are also a number of designs incorporated into the building to control or reduce the solar heat gain. "It has a tight and energy efficient skin, but the big story is the energy savings we achieved," says O'Connell. "We were able to achieve a 30% energy savings over the standard ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) model. And that's unique for a lab building in general, but especially for a lab building like this."

All of the air in the building is once-through air, even on the office side, in order to mitigate the chances of any type of contamination or cross contamination in the forensic samples and evidence. "Safety is like a three legged table," says William Vosburgh, Director of the CFL, who reports to the Office of the Deputy Mayor for Public Safety and Justice for the District. "First you have the safety for the worker, then you have safety for the surrounding neighborhood, and then you have safety for your forensic evidence. The evidence cannot be cross contaminated or be contaminated by the workers," he says. "I think that we've engineered all the various safety standards and a lot of air changes depending upon the work space."

All of the air that comes into the building utilizes chilled beam technology, both on the office and on the lab sides. "You get most of your heating and cooling at the terminal unit when you use chilled beams," says HOK's O'Connell. "What that means is that you're able to drive down the amount of air changes which means that we need fewer air handlers. Actually, if we did an all air system, we would need two more very large air handlers. So we were able to reduce the number of air handlers which means that we were also able to reduce the size of the chiller and boiler plants."

The CFL also employs heat recovery techniques in all of the air handling units, so any exhaust that comes from the offices and more benign spaces is run through enthalpy wheels. All of the lab exhaust or contaminated exhaust goes through a glycol run-around loop to help save energy.

However, the design technique that resulted in the largest savings and is probably the most unique feature in the CFL's sustainability is the use of a heat-shift chiller. This device takes heat gain from electrical rooms and heavy equipment intensive areas, such as cold rooms. It takes the heat reject from those spaces and puts it through a heat exchanger to reduce or eliminate the regular reheat for the building. With a building the size of the CFL and its number of air changes, the conditioned air creates an environment where some spaces might be too cold. Traditionally what's done is to fire up boilers to make hot water and reheat that air at the terminal unit with a fan coil or something of that nature. The heat shift chiller eliminates that requirement. Rather than taking the heat from these electrical closets and hotter areas and rejecting it through the cooling tower, it's actually being reused, creating significant energy savings.

Forensic Diversity

In addition to the building's sustainability, there are a number of unique forensic-based features. One of the most notable features is the CFL's Vehicle Exam Bay and vehicle exam booths. "This is a garage on the below grade level that's essentially large enough to fit a whole car where investigators can deconstruct and process the car from a forensics point of view, mostly for fingerprinting, but also to extract any other forensics evidence, such as trace evidence or firearm evidence if the car has been involved in a shooting," says O'Connell. This is a very controlled laboratory-like environment where the investigators can use super glue for fingerprint identification or look for other evidence. It's also air-conditioned to preserve the integrity of the evidence. If any questions arise during the processing of the vehicle, other labs and investigators, such as those in the firearms and toolmarks units are only an elevator ride away. The Medical Examiner in the CFL can be called upon to determine the cause of death of any bodies found in the car. The Public Health Lab in the same building can identify whether any white powders found in the car are a biological agent or drug. And the MPD in the same building can ascertain whether or not that material is part of a bigger drug ring or previous case.

There are other forensic-based features in the CFL like an indoor firing range and a bullet-recovery tank. The CFL also has a BSL-3 (biosafety laboratory-level 3) for examination of various materials up through anthrax, although most of the anticipated use will be for

PowerPlex® Y23 System

With the ability to amplify 23 Y-STR loci, the PowerPlex® Y23 System has the highest discrimination power of any commercially available kit. Detecting more loci enables laboratories to:

- Reveal more Y-STR loci in the presence of excess female DNA
- Save time in every run, using rapid cycling technology
- Obtain a full profile from precious samples, even those with high concentrations of inhibitors
- Simplify workflows with one kit for both casework and database samples

Promega

For more information, please visit:
www.promega.com/powerplexY23

©2012 PROMEGA CORPORATION. 22225-1564

rabies and tuberculosis. The Public Health Lab is part of the lab response network that answers to the CDC (Centers for Disease Control and Prevention). As such the BSL-3 lab is within the Public Health Lab portion of the building and has all the usual engineering to keep it clean and safe. A unique feature of the BSL-3 lab is that most of the spaces are on the building's exterior wall to get natural light into those labs. Most other labs avoid that configuration, but the HOK designers were able to design and construct an exterior wall tight enough that there are no air leakage concerns.

Design Functionality

"The bones of the building are very strong, it's heavy-duty concrete," says Vosburgh. "The building was designed to withstand a lot, not just vibration, the architects call it a controlled collapse construction. If there ever was to be a problem, it's not just going to fall over."

Power supplies for the CFL are also heavily redundant. There are two power feeds to the building via underground power connections from Pepco (the District's electric utility). There's also a rooftop generator. A plug-in plate on the first floor allows a second generator to be brought in and plugged into the building. And then there are UPSs (uninterruptable power supplies) throughout the building. "So basically, we're not going down," says Vosburgh. "We're a first responder building; involved in crime scene investigations, medical examiner work, and a public health lab—we have to stay online. Our mission is to continue to provide high-quality, timely service to our customers. Our customers are investigators of one sort or another, whether its police or medical examiner or public health workers who collaborate with hospitals and work to help diagnose infectious diseases."

Figure 3: Collocation with the medical examiner facility makes forensic investigations more efficient.

The first floor has a lot of shared facilities—there is a lecturing lab and a wet training lab. "The lecturing lab has windows into the wet training lab," says O'Connell. "Groups of high school students or someone on a field trip can look into an operation that's happening in the wet lab, which is probably perfectly safe but the windows mitigate any risk. That wet training lab also has video-teleconferencing capabilities so CFL personnel can do distance learning or distance training in that lab."

Vosburgh's concept is that as CFL managers bring in experts to train their staff, they'll be able to sell some of the seats to surrounding jurisdictions to come in for training as well. This will generate revenue for the CFL and could offset the cost of the training. This also starts to facilitate the collaboration between the CFL and other local jurisdictions which is always helpful.

The medical examiner also has an operating theater, a nice additional feature giving police investigators direct access to the medical examiner. It allows for training by other agencies as well.

The CFL has a tremendous IT infrastructure that was built with the future in mind. "When you go into forensic labs that are 10 or 15 years old, you can see that the designers did not prepare for the evolution of IT as it applies to forensic operations," says O'Connell. "We feel that we've done a lot to accommodate for today's and future needs."

Operational Efficiency

So will the three forensic groups work together? "I guess we're going to find out," says Vosburgh. "Most of these groups already work together as part of the mission to solve problems. We have an independent medical examiner and they will remain independent. The crime lab portion that was under the police department (MPD) namely firearms, fingerprint, DNA, and trace evidence is going to spin off into its own agency—the Dept. of Forensic Science. To eliminate any perceived conflict of interest, we've given pure scientific management to the operation. And there will be budgetary independence. We should not have to suffer any trickle down economics from being within a much larger organization."

The public health lab which was under the District's Dept. of Health will be folded into the new Dept. of Forensic Science. All of this is scheduled to take effect on October 1, 2012—the beginning of the District's new fiscal year. "So the Dept. of Forensic Science will hold those two components—the crime lab and the public health lab—the medical examiner stays independent, and the crime scene units are currently a hybrid, they're mostly sworn police officers but they're transitioning to civilian scientists. And they're stationed in the building as well," says Vosburgh.

The "super-user" in the building—the new Dept. of Forensic Science—is basically the owner of the building

Thermo SCIENTIFIC

smarter FT-IR

Never before has a research grade FT-IR provided more information, in less time and more easily. The revolutionary design of the **Thermo Scientific Nicolet iS50 FT-IR Spectrometer** allows any user to move from one experiment to another with the push of a single button—integrating ATR, Raman and NIR. Hyphenated techniques are part of its versatility. TGA-IR and GC-IR functionality are coupled with powerful automated data analysis tools to extract information quickly and consistently, eliminating literally hours of data analysis. Smarter spectroscopy, exemplified.

easily do more

• discover easy versatility • thermoscientific.com/iS50

© 2012 Thermo Fisher Scientific Inc. All rights reserved.

iS50 Raman Module
Mapping and well-plate screening in sample compartment mounted module

iS50 ATR Module
Leaves main sample compartment free for other analyses

iS50 NIR Module
Develop QC methods for bulk samples

and assigned to settle any intra-departmental conflicts. "We didn't want to end up standing in the Deputy Mayor's office every time we had a spill and nobody wanted to clean it up," says Vosburgh.

A safety officer, funded through the Dept. of Forensic Science, has building-wide inspection authority and is able to inspect the building from top to bottom and take corrective action for safety as needed.

Maintenance for the CFL is outsourced to the Donohoe, one of the District's largest maintenance contractors. "The District's Dept. of General Services has contracted with Donohoe to maintain the CFL, it's so complex. And that means everything from janitorial up through electrical, plumbing, and HEPA filter changes and various things that go on in the laboratory," says Vosburgh. "They're big in the city here, they have a lot of complex buildings as clients that include hospitals and other research labs."

Get a sneak peak of the CFL facility on The Evidence Conference's facility tour!
www.theevidenceconference.com

The other piece controlled by the District's Dept. of General Services is security. "We're in a dense urban setting and we have to be secure," says Vosburgh. "So we have a 24/7 miniature police force that keeps the building secure and guards it at all the access points, which includes everything from key badges to video cameras at key areas. There are layers of security, including at the highest level biometric iris scans to gain access to evidence rooms. An evidence room is going to need a standard ID badge to get anywhere near it and then an iris scan to get into it, and then there are cameras on that room as well."

As noted earlier, sustainability was an important aspect of the CFL. "There are two issues regarding sustainability, one is concerned with the physical facility and the other with the program," says Vosburgh. "The physical facility was designed not only to be incredibly sturdy, but with a gracious amount of space to grow into because in the current dense urban setting we're not going to be able to add an extra wing or an extra floor in the future. We've got to be able to grow within the box. As lab technology changes, you sometimes wish to reconfigure the amount of space you need for certain projects. So the way we dealt with that was by leaving as many labs as open as possible and with as few walls as possible. So we can reconfigure our scientific workspace within our lab. Of course where certain rooms are specialized and do need to be walled off, they are, but we really do have a large amount of space and we made sure that it could be repurposed and easily reconfigured going forward."

CFL 2

The District of Columbia operates under a COOP plan, or continuity of operations. Regardless of the backup plans that are built into the CFL, a secondary site is maintained at Blue Plains in far southern D.C. This site has a BSL-3 annex for public health threats along with a large evidence warehouse for long-term storage. There are also some other police operations there that can function at a rudimentary level if needed. This site is completely operational. The CFL is also attempting to create a mobile capability that would allow work to continue with some master disaster-type planning.

The current process for the CFL is to have investigators go to a crime scene, bring back the evidence to the CFL (which could include a whole vehicle for analysis in the Vehicle Exam Bay), document the evidence, properly package the evidence, and submit it to an Evidence Control Center on the first floor where it will be bar-coded. The evidence is then distributed and sequenced to the appropriate analysis areas (firearms, DNA, fingerprint). It's then returned to the Evidence Control Center where it might be held for court or (more likely) sent to the long-term evidence warehouse in Blue Plains where it can be held, by statute, for up to 65 years.

Tim Studt *is the Editorial Director of Forensic Magazine.*
tim.studt@advantagemedia.com

TrueAllele® Technology
Products & Services
An Integrated Solution for Preserving DNA Information
Automated DNA Interpretation & Match

TrueAllele Casework
- Resolves DNA mixtures with 2, 3 or more unknown contributors
- Handles challenging evidence including degraded & touch DNA
- Includes familial search and match capabilities
- Admitted into evidence and upheld in court

TrueAllele Reference
- Easy to use NDIS approved single source Expert System
- Provides validation tools for rapid NDIS validation process

TrueAllele Database
- Automates fully informative DNA search and match
- Creates customizable DNA databases
- Operates within a single laboratory or across multiple locations

TrueAllele Services
- Solves challenging cases, backlogs, and victim remains
- Prepares case reports for investigative and court purposes
- Restores DNA match statistics affected by SWGDAM guidelines
- Provides expert witness preparation and testimony

Science • Technology • Integration
Productivity Tools with Proven Reliability
Cybergenetics
(412) 683-3004
info@cybgen.com
www.cybgen.com

The first step in **inexpensive, high-throughput** detection of K2/Spice metabolites in urine

Quick **yes or no screening** allows you to ID positive samples before investing in LC/MS

Cayman CHEMICAL

Detects the parent molecules, oxidized metabolites, and/or glucuronides of these synthetic cannabinoids

JWH 018
JWH 073
JWH 200
JWH 122
JWH 398
AM2201
MAM2201
JWH 019
JWH 022

Item No. 580210

JWH Metabolite ELISA Kit

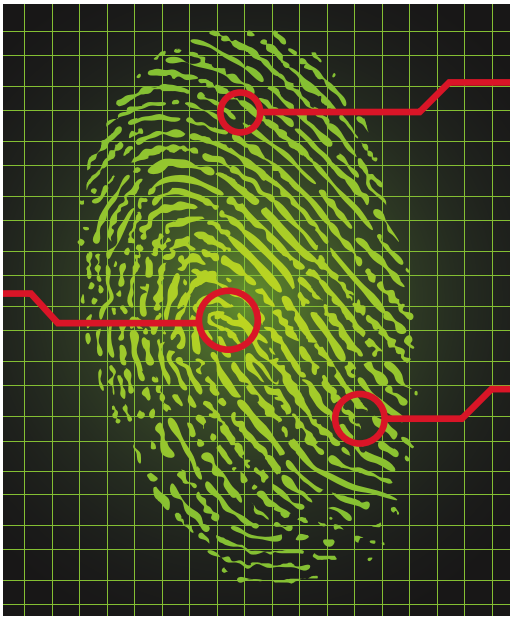
(Qualitative)

ELISA format optimized for results in just a few hours • Correlates with LC/MS data
Validated in human subjects

visit www.caymanchem.com/jwhkit to learn more
contact us at sales@caymanchem.com

Defining AFIS Requirements

Clearly defining your workflow and specifying your system requirements will ensure you get the Automated Fingerprint Identification System your agency needs.



Bob Beall

Whether upgrading an existing Automated Fingerprint Identification System (AFIS) or procuring a new system, law enforcement agencies all too often discover that the AFIS they thought they bought isn't the one the vendor plans to deliver. This is often the result of misleading information provided in response to unrealistic or vague requirements.

To avoid such misunderstandings, vendors and customers need to establish a common understanding of AFIS requirements. By clearly defining your requirements up front you also "protest-proof" the RFP and subsequent purchase decision. Before issuing an RFP, thoroughly understand—and document—your business processes and essential requirements.

Know your Stakeholders

You need to specify a system with comprehensive AFIS capabilities. At the same time, your agency has numerous stakeholders in the procurement with competing priorities.

Financial managers need a system that delivers low cost of ownership over its total life. It must be the most cost-effective not just in year one, but for five to ten years. Proposed solutions should allow technology refresh at component or subsystem levels, providing incremental updates throughout the system's life.

IT department requires the AFIS adhere to industry standards for databases, interfaces, and COTS hardware and software. The system needs an extensible architecture that fits the agency's overall IT environment.

Latent examiners require a highly accurate system that allows them to efficiently and collaboratively manage case work. They require a user-friendly interface with very high image resolution and powerful tools for enhancing poor quality latents, editing/viewing/marking minutiae, and documenting match decisions for court testimony. They need a vendor committed to interoperability and biometric standards developed by NIST, INCITS, and FBI.

Tenprint technicians require a highly accurate matching system with fast response times that allows quick, efficient management of a very large number of searches. They require an efficient user interface with powerful tools.

System Managers/Supervisors require easy management of user permissions, with definable roles and responsibilities. They need to see what work is performed for proper resource allocation during regular and peak workloads. They must be able to configure rules on a workflow (Type of Transaction) basis. Supervisors require management reports detailing work performed by their unit or individual users for date range or work type.

System Administrators require integrated tools to view the current system health (hardware and software), and alerts to potential problems. They require tools to manage the backup and restore process.

ID bureau manager looks at the big picture. He wants the fastest, most accurate matchers and clear vendor commitment to criminal justice, forensics, and public safety. The system must provide not only the best ID tools for a variety of needs, but also a roadmap for future development, and a robust support organization.

Quality Matters

We know everything that happens in your lab has an impact—on victims, on defendants, on the justice system, on your credibility. Even with all of the constraints you face, you simply can't neglect accuracy and attention to detail.

Which is exactly why labs like yours rely on ASCLD/LAB. We're the only accreditation program focused solely on crime labs. We've been helping crime labs and crime scene programs support a higher level of justice for over 30 years.

Simply put, we help crime labs stay on top of their game. And above reproach.

AMERICAN SOCIETY OF CRIME LABORATORY DIRECTORS
LABORATORY ACCREDITATION BOARD
LAB

Crime lab accreditation starts here: ascld-lab.org

Quality Matters™

Balancing Act

Balancing stakeholder needs is essential. You can satisfy both management, who want a solution that optimizes precious resources (e.g. lights-out automation) and forensic examiners, who want 100% review, by selecting a flexible system that supports lights-out exception processing and is tunable without vendor change costs.

Developing a relationship with AFIS vendors early in the process helps you gain an understanding of their offerings. This in turn helps you define an AFIS that meets your needs.

Consider releasing a Request for Information (RFI) to AFIS vendors. Responses typically do not exceed ten pages and help you understand their current offerings. Vendor RFI responses can also be an indication of their willingness to work with you.

Create a draft Request for Proposal (RFP) and send it to AFIS vendors for comments. Again, their responses clarify their AFIS capabilities and signal their willingness to work with you.

Use standard vocabulary in the biometrics requirements. Such terminology can be found in ISO SC37 Harmonized Biometric Vocabulary (Current Version Document 2 Version 12 - dated 2009-09-16).

When you release the RFP, be sure to include a period when vendors may ask clarification questions. (And be sure you respond in a timely manner.) You may also want to schedule an on-site facility tour and/or a live vendor question and answer session.

When thinking about your new AFIS, focus on the problems to solve as opposed to how to solve them. While there are often "how" elements imposed by statute or policy, in many cases these are based on habit. By taking the "what is my problem" approach with only the "how to solve it" aspects that your agency is obligated to follow, you enable conflict resolution among stakeholders and allow vendors more latitude to assist. This approach also opens the door to the best possible solution.

Understand and Document Process

You must define your workflow (or the new desired workflow) to really get the AFIS you want. Document your process, describing what happens when a tenprint or latent arrives in the lab. How is it encoded—by whom? Who reviews encoded images and search results? How is your database organized?

Tunable workflows: Different agencies require varying levels of operator intervention based on transaction type, certainty of the match result, or time of day. You may want to specify lights-out operation based on workflow type and/or matching score threshold and other parameters. Vendors should allow you the flexibility to "tune" settings yourself, saving you a support call every time a change is necessary.

Earn a Master's
IN DIGITAL FORENSICS
with Champlain's Online
Graduate Studies Programs
• MASTER'S IN DIGITAL FORENSIC SCIENCE
Our highly specialized programs allow for more in-depth, hands-on learning.
• MASTER'S IN DIGITAL FORENSIC MANAGEMENT
Addressing the specific needs of management in the field of digital forensics, preparing students to become leaders in this rapidly growing field.
• PRACTITIONERS OFFERING REAL-WORLD LEARNING
Our project-based format features online instruction by faculty with nationally recognized, real-world experience.
For more information:
CALL 1-866-282-7259
CHAMPLAIN COLLEGE
Graduate Studies
champlain.edu/dfmdfs
EXPERIENCE LEARNING.

Role-based access: AFIS workstations have evolved into multi-function workstations with capabilities defined according to which user is logged on in which role. System access should be based on a user's defined role. Roles are defined by a system manager, and users can be assigned to one or more roles, depending on their job. Role defined access provides greater control over sensitive AFIS data. If you want workstations to perform only one function, make this clear in your specification.

Rolls and flats storage and matching: The latest generation AFIS store both rolled and flat fingerprint images for each record for "twenty-finger" matching. If your proposed AFIS does not have this capability, you will lose match opportunities since there is a 20% accuracy improvement with this approach.

1000ppi and 500ppi in the same database: AFIS standards are evolving from 500ppi to 1000ppi, especially for latents. But many agencies have records still encoded at 500ppi. Your system should allow records of both sizes.

Business continuity: The term *business continuity* describes a daily business methodology, whereas business continuity *planning* defines what that methodology should be. The business continuity *plan* is the methodology followed to ensure normal operations in a disaster. Specify your business continuity policy and how quickly you must recover from system failures. State your policy and define which systems and operations are within the requirements and which are not. Be specific about your expectations if your main site goes down.

Specify meaning if you prohibit a "single point of failure." Does it apply only to workstations and servers, or also to printers? If applicable, define "degraded mode." What operations must continue in degraded mode?

Finally, specify if system Uninterruptible Power Supplies (UPS) are available or must be provided by the vendor.

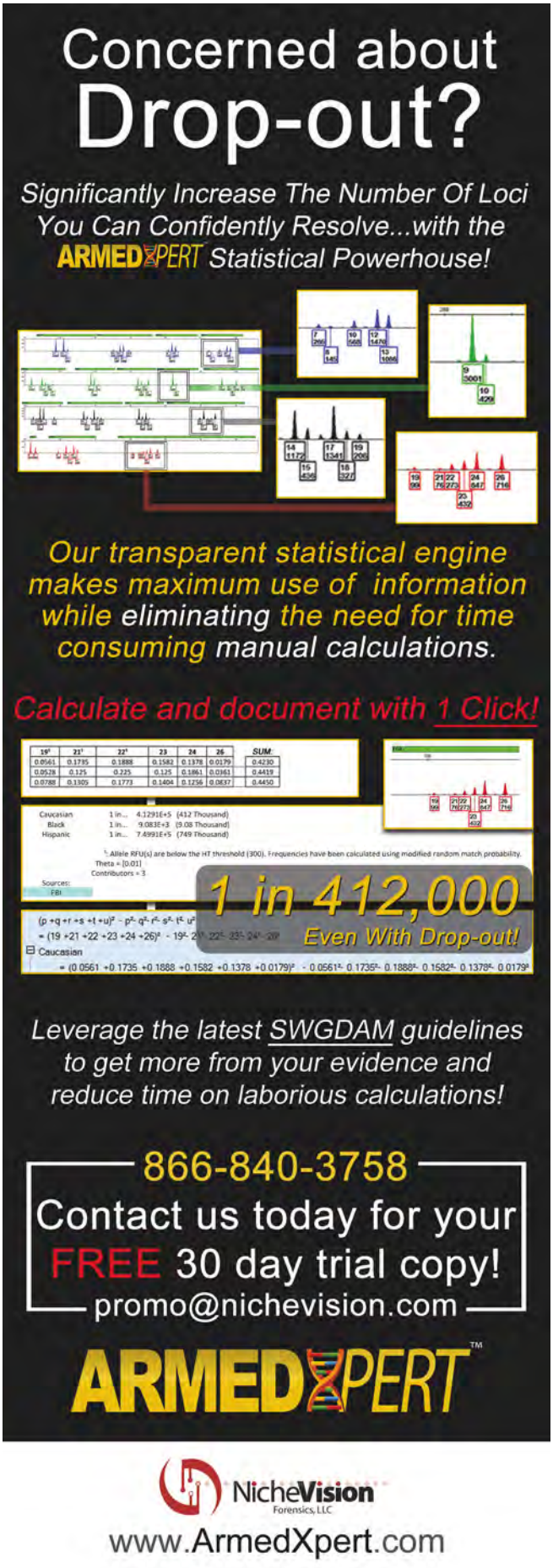
If you do not make your needs clear, vendors may propose the least expensive approach instead of the one that meets your availability requirements. Or conversely, they may over-engineer the system, adding unnecessary cost.

24-hour support center: Is it important that the AFIS vendor maintain 24-hour support with live problem troubleshooting? Specify the hours you expect support to be available—and the type of support provided.

CCH and other interface capability: What other databases does your agency maintain? Do you expect to exchange data with them? What about remote interfaces to the FBI, to the state AFIS (if applicable), or to other states? You need to specify your desired workflow and the type and format of data to be exchanged.

Essential Requirements

In addition to documenting your high-level process-related requirements, it is important to specify needs in


Concerned about
Drop-out?
Significantly Increase The Number Of Loci You Can Confidently Resolve...with the ARMEDXPERT Statistical Powerhouse!
Our transparent statistical engine makes maximum use of information while eliminating the need for time consuming manual calculations.
Calculate and document with 1 Click!
1 in 412,000
Even With Drop-out!
Leverage the latest SWGDAM guidelines to get more from your evidence and reduce time on laborious calculations!
866-840-3758
Contact us today for your FREE 30 day trial copy!
promo@nichevision.com
ARMEDXPERT™
NicheVision Forensics, LLC
www.ArmedXpert.com

several additional categories.

Functionality must be considered for tenprint and latent operations. Are livescans or mobile identification needed? To achieve an integrated system in which all components function seamlessly, tell vendors the problems to solve and require them to specify how their system solves them. Specifying the problem and allowing the vendors the flexibility to reply with their standard solution will decrease system cost, as well as delivery times and risks.

Performance expectations need to be defined. Define the period you are measuring. Ensure it doesn't include variables like operator actions beyond the vendor's control. Specify expected search engine response times, measured from transaction receipt to completion, for each type of transaction.

Accuracy is one of your agency's top priorities. Learn the current state of accuracy capability in the industry. You want to encourage vendors to push technology forward. But it's unrealistic to specify a search accuracy level far beyond that proven by vendors. This invites misleading or untruthful responses that could lead to flawed vendor evaluation where vendors simply state "comply" to requirements that are clearly unproven by independent testing. To be realistic, accuracy requirements must take into account factors like image quality and number of matching minutiae.

User interfaces can vary widely from AFIS to AFIS. Are all commonly used functions available on the same workscreen, or are several "clicks"needed? Can users customize screens by moving panels, use all the space on monitors, change colors and fonts used? Do user preferences follow them from workstation to workstation? Do GUIs follow best practices thus reducing training time? Can system administrators easily access system information?

Availability and downtime requirements are often driven by business continuity planning and specify the maximum unscheduled system downtime. It is important to precisely define the meaning of "downtime." Is the system "down" if any component fails, or must all fail? Does your downtime definition apply only to database servers, or are components like workstations included?

Include in your downtime definition a realistic allowance for routine maintenance and upgrades.

You may think your AFIS needs 99.999% availability; but is your system so mission critical that you can only tolerate five minutes of downtime per year? That capability will come at a cost, so it is important for your agency to determine a realistic reliability requirement.

When considering availability and downtime, be wary of the term "fault tolerant." Fault tolerant specifically applies to systems delivering 100% availability. Such systems exist but at extremely high cost in terms of hardware, software, and infrastructure. It's unlikely a truly fault tolerant system will be delivered at a price agencies are willing to pay.

Finally, when specifying availability, consider network infrastructure limitations. Uptime and availability are not synonymous. A system can be up, but unavailable, as in the case of network outages. When calculating system uptime, the AFIS vendor cannot be held accountable for network failures. The network must be able to support your desired availability.

Price: Don't fall into the trap of thinking all AFIS are alike with the only differentiator being price. With AFIS, you truly do get what you pay for! With too much emphasis on system price, you run the risk of purchasing an inferior system and incurring costly change orders for add-ons to get the system you need.

Advanced Oracle 11g: Most AFIS vendors use Oracle for database management. But not all vendors take advantage of Oracle's advanced capabilities. A vendor with Oracle expertise can deliver a better, more robust system without cutting corners. For example, the entire database should be stored within Oracle using SecureFiles and use Oracle Maximum Availability Architecture. Both technologies guarantee zero data loss while meeting performance and uptime requirements. Also, advanced vendor expertise in Oracle eliminates database headaches for onsite staff.

COTS hardware: All AFIS hardware should be industry standard, readily available, commodity commercial off-the-shelf (COTS). Proprietary hardware increases cost, constrains you to one vendor, and limits ability to have a system fully integrated with your IT environment.

COTS 3rd-party software: Your AFIS vendor will undoubtedly use standard software for their operating system and workstations, as well as for database storage and AFIS software development. You will have better results with future upgrades if the system also conforms to current open software standards. AFIS application coding should use an N-Tier open environment such as Java and data should be stored in XML open format.

Architecture: Your system should leverage the latest computer industry advances and have the flexibility to move with current IT best practices. The current best practice for complex system architecture is a Service Oriented Architecture (SOA). SOA allows flexibility of new services or service versions to be "plugged" in to the system with little or no effect on other system services in use. When your vendor releases an improved matching algorithm, Service Oriented Architecture allows system updates without having to replace other AFIS parts.

Current AFIS Standards

While your AFIS needs to conform to the latest standards, beware of irrelevant fingerprint standards. Inclusion of irrelevant standards, such as ANSI/INCITS 377 and

ANSI/INCITS 398, leads to confusion and may introduce mutually exclusive requirements.

Clearly identify relevant standards that the system must adhere to and make them available to vendors for reference. A Web site link where they can download the standards is sufficient.

NIST ELFT participation: The National Institute of Standards and Technology conducts ongoing AFIS accuracy benchmark tests. Since participation is voluntary, some AFIS vendors choose to not take part. Require your vendor to state if they participate in the tests and their ranking. Current ELFT test results for low quality latents range from zero to 20% accuracy where the matching print is in the first respondent position. See www.nist.gov/itl/iad/ig/ansi_standard.cfm.

ANSI/NIST ITL: This biometric data format specification is defined by the National Institute of Standards and Technology and is updated every five years. The current specification is the recently released ANSI/NIST ITL 1-2011. This update to NIST's biometric data standard adds DNA, footmarks, and enhanced fingerprint descriptions for marking extended feature sets. See www.nist.gov/customcf/get_pdf.cfm?pub_id=910136.

FBI CJIS EBTS: The FBI Criminal Justice Information Services Division has a specification known as EBTS (Electronic Biometric Transmission Specification). Though fingerprints are the FBI's primary identification mode for the near future, the scope of the EBTS has expanded. It now includes additional biometric modalities such as palm print, facial, and iris. The current version is EBTS v9.1 XML IEPO. See FBI Biometric Center of Excellence: www.fbibiospecs.org/ebts.html.

Integrating biometric data according to ITL and EBTS standards provides descriptions of all requests and responses associated with electronic fingerprint and other biometric identification services.

With only a small number of vendors offering AFIS, determining which one will give you the best system doesn't have to be a coin toss.

If you specify mandatory versus optional capabilities; define your proposal rating system; and require clear-cut pricing tables, you are in a better position to make a purchase decision that you will be happy with for the next decade.

Bob Beall *is the AFIS Solutions Product Manager for MorphoTrak, Inc. MorphoTrak, Inc. 113 South Columbus St, Alexandria, Virginia, 22314; 1.800.601.6790; bob.beall@morpho.com; www.morphotrak.com*

CLEAN PRINTS...FIRST TIME, EVERY TIME.
PRESCAN
FINGERPRINT ENHANCER
Identicator
PRESCAN™ FINGERPRINT ENHANCERS
Identicator® PreScan™ pads feature a special ridge enhancing formula that accentuates the fingerprint detail of those with worn or light ridge detail. Additionally, the special ceramic pad applies the perfect amount of solution to the skin to make the best contact between the finger and the scanner, every time.
Buy Two Large PreScan™ Pads, Get One FREE!
Purchase two Large PreScan Pads (#1007823) and get one for FREE, you save $63.00!
Use Promo Code 20124243 when placing order.
Offer valid August 1, 2012 thru September 30, 2012. Cannot be combined with any other offer. No substitutions.
FORENSICS SOURCE
www.ForensicsSource.com • 800.347.1200
FMA0812 © Safariland
SAFARILAND. Together, We Save Lives.™

Presented by Forensic Magazine® and DFI® News

TRACKS ON CRIME SCENE, FORENSIC LABS, AND DIGITAL AND MOBILE DEVICE FORENSICS.

Get a Handle on the DIGITAL and MOBILE DEVICE EVIDENCE you collect

FORENSIC LABS AND DNA:
KEYNOTE PRESENTATION: "So You Want to Build a New Crime Lab…"
Dr. William T. Vosburgh, Director, DC Consolidated Forensic Laboratory

DIGITAL AND MOBILE DEVICE FORENSICS:
THE CELLPHONE AND GPS TOOL CLASSIFICATION SYSTEM:
A review of over 40 different cellphone forensic tools

CRIME SCENE:
"I'M TOTALLY OBJECTIVE AND I HOPE THEY NAIL THE SCUM!"

Washington, DC
October 1-2, 2012

THE EVIDENCE CONFERENCE

AT THE SCENE. IN THE LAB. WWW.THEEVIDENCECONFERENCE.COM

Platinum Sponsor: cellebrite delivering mobile expertise

Silver Sponsors: HBGary Detecting Tomorrow's Threats Today · METTLER TOLEDO · fernico make the work flow. · nuix · Vound Intella

WWW.THEEVIDENCECONFERENCE.COM

The New Face of Forensic Science

Brains, Design Intellect, and Beauty—a Complete Package

Susan Halla and
Keith Whittle Green

Welcoming.
Collaborative.
Open.
Educational.
Bright.
Sexy.

Figure 1: The Johnson County Sheriff's Office Criminalistics Laboratory. A welcoming exterior acts as an ambassador to the public. © Joe Atchity

These are not words that are ordinarily attributed to forensic facilities, but with the new standard of buildings, these words have become paramount descriptors of the new face of forensic science. Previously such words may only have been attributed to laboratory facilities from privately funded scientific ventures or high-profile university work. However, current economic factors for construction along with smart and fresh design have brought these adjectives into reach for every forensic facility.

The Tucson Police Department Crime Laboratory headed by Susan Shankles was completed in September of 2011. Just shy of 60,000 square feet, the facility had a construction cost of $22 million and houses eight forensic specialties: forensics/electronic media, forensic biology/DNA, latent prints, trace chemicals, arson, explosives, controlled substances, firearms, and toxicology. The Johnson County Sheriff's Office Criminalistics Laboratory in Olathe, Kansas, is headed by Gary Howell and was completed in March of 2012. This facility is 62,500 square feet and also has a construction cost of $22 million. The lab is comprised of seven forensic departments: serology/DNA, trace evidence, controlled substance analysis, firearms and toolmarks, latent prints, crime scene investigation, and digital forensics. Each of these facilities embodies the characteristics of the words above. Each of these facilities too, was completed on time, on budget, and is an exceptional steward of the public money bestowed upon it for construction.

Green

Both of these new facilities, as most new facilities built under the auspices of a governmental agency, are pursuing accreditation through the LEED (Leadership in Energy and Environmental Design) Program developed by the USGBC (United States Green Building Council). The USGBC bestows four levels of accreditation upon buildings that meet increasingly stringent levels of sustainable building practices; the lowest level being Certification, continuing to Silver, Gold, and at the highest level, Platinum accreditation. Each of these buildings has surpassed the LEED requirements set by its community; the Tucson Police Department Crime Lab is pursuing Gold Certification and the Johnson County Criminalistics Center will be the first forensic facility in the country to achieve Platinum Certification under the current USGBC requirements.

Meeting such stringent environmental requirements necessitates much forethought in design and utilizes many varied sustainable measures to meet the goals set by USGBC. The sustainable design features of the Tucson facility include the collection of rainwater from the roofs in an underground cistern supplying

3-hour STR amplification slowing down your lab?

Rapid PCR is here.

The **Streck Philisa® Thermal Cycler** enables your lab to improve STR amplification time from 3 hours to less than 17 minutes. Using the **Philisa Thermal Cycler** and primer sets from commercially available kits, perform rapid PCR amplification for faster human identification – the fastest HID amplification available on the market today.

Rapid ramp rates of up to 15°C/s heating and 12°C/s cooling, thermal accuracy, and innovative thin-wall tubes promote efficient heat transfer throughout the system. A compact netbook with simple yet versatile Windows®-based software is included along with a 2-year thermal cycler warranty.

The ability of the **Philisa Thermal Cycler** to accurately perform multiplex PCR amplification in less than 17 minutes has been demonstrated. See the Application Note at **www.streck.com**.

Contact your Streck Representative to request an in-lab evaluation.

Streck | 866.544.0015
www.streck.com

100% of the irrigation needs of the native desert landscaping of the site, large roof overhangs and automated roller shades to manage the intense southern summer sun, low-flow plumbing fixtures to conserve water use, a sophisticated mechanical system utilizing variable air volumes with hydronic reheat, and parking lot shade structures with photo-voltaic arrays. As a testament to the power of sustainable design, the Tucson Police Department Crime Laboratory received a rebate check for over $47,000 from the Tucson Electric Power company at the grand opening of the facility. The Johnson County Sheriff's Office Criminalistics Laboratory project has implemented ground source heat pumps and an enthalpy wheel as part of an equally-sophisticated mechanical design. Other energy savings

Figure 2: The Johnson County labs have open laboratory environments that allow clear views of those working and space for future staff expansion. © Joe Atchity

measures unique to this project are roof-mounted solar arrays and a vegetated roof structure. As shown by the Tucson financial rebate, sustainable design can mean real savings for taxpayers for the day-to-day facility and operational costs.

Welcoming

Forensic facilities are visited every day by different groups of people, so it is crucial that they present an accommodating welcome for visitors as well as the inhabitants. Outside agencies, visiting educational groups, and governmental dignitaries—all of these groups are well served by providing a presence that welcomes and invites. Groups are particularly tricky to accommodate; many agencies including the Tucson Police Department Crime Laboratory organization do not allow tour groups to enter laboratory spaces at any time. Allowing well-placed windows for views into the laboratory can be one key to solving this issue. Intelligently designed layouts of publicly-visible private spaces can also help to provide a welcoming nature to visitors. The Johnson County facility has one front door for all visitors—agencies and groups alike—but has specialized areas for accommodating each of these groups while maintaining overall facility security.

Collaborative

Each of these organizations is moving from conditions where the analysts of various areas were working in exceedingly cramped quarters, to spacious, modern facilities. With this decanting of people to much larger spaces comes the potential loss of camaraderie and collaboration. While each group within the forensic facility requires spaces that are secure and unique to their individual specialty, designing collaborative spaces in new facilities mitigates the risk of losing this collaborative sense; sometimes forced togetherness is important.

In the Johnson County Sheriff's Department Criminalistics Laboratory, a two-story atrium was placed in the midst of all of the individual laboratory spaces. It has been named "Locard's Plaza" in honor of the French pioneer of forensic science, Edmond Locard. The Plaza houses library materials for general reference along with comfortable furnishings that can be rearranged for one-on-one or group discussions. Close by are conference rooms available for larger or more private conversations. Additionally, the break room and adjacent outdoor patio provide more zones for inter-group collaboration.

The Tucson Police Department Crime Lab also has a central two-story atrium ringed by laboratory, office,

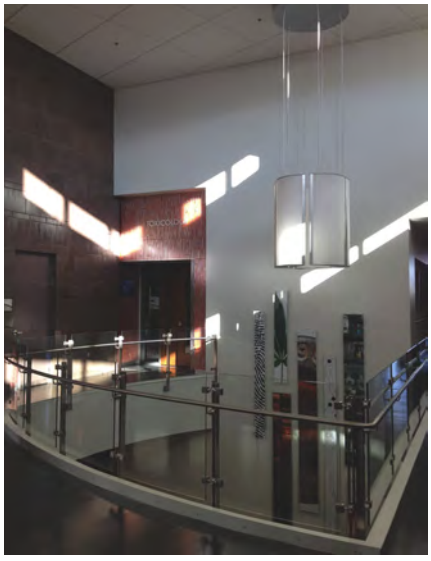


Figure 3: In the Tucson Police Department Crime Lab, the entrance to each section has a display area where each unit has set up information about what they do.
By Keith Whittle

and meeting spaces. Similar comfortable and movable seat groupings can be found here as well. The open atrium of the Tucson facility is crisscrossed by various bridges and walkways encouraging accidental meetings by various groups within the laboratory as they navigate from evidence intake back to lab or from office to break areas.

Open

Particularly when it comes to safety, an open lab can be a safe lab when appropriate for the application being performed. Both the Tucson and Johnson County labs have open laboratory environments that allow clear views of those working in the lab. Spaces are also adequately generous such that future expansion can occur to staffing of the laboratory spaces without sacrificing the safety of inhabitants or evidence.

Space considerations are not only for the actual floor area of a lab but also for its volume. Both facilities have an adequate ceiling height of 10 feet in most laboratory spaces to provide vertical volume that enhances openness and comfort. In the Johnson County facility, the crime scene investigation unit has three vehicle processing bays. The placement of these bays under the mechanical room allowed for much higher-than-normal ceiling heights, by raising the upper floor four feet higher relative to occupied areas which means that the ceiling heights of the vehicle bays are just over 19 feet. This height is tall enough to lift even large-scale passenger vehicles and some commercial vehicles.

Educational

All new forensic facilities will be asked time and again for tour opportunities. Quite often these tour requests are from other facility managers who are in the early planning stages for their facility. These are groups that know the science and to whom the educational aspect is not a primary goal. However, most laboratories will be required to provide educational tours to other groups: police cadets, visiting political dignitaries, school groups, citizen's academies, or even the general public, if it is prescribed as necessary by the local jurisdiction to provide openings for community citizens to come to tour. Providing educational instruction to these groups by communicating the important role a forensic facility plays in the community is an aspect not to be forgotten.

In the Tucson Police Department Crime Lab, the entrance to each section has a display area where each unit has set up information about what they do and the tools that they use to perform their work. Tucson has also taken the time to interview the individual sections about their work and edited these into short video presentations that can be shown to visitors explaining the intricacies of each individual unit. The Johnson County laboratory has similar department-specific displays and also provides visitors with a touch-screen kiosk in the lobby that highlights the sustainable features of the facility and explains, for example, real time information about how much energy consumption is lowered or what energy cost savings have been realized. Educational spaces in the Johnson County facility also include a large training room located on the public side of the security zone that can be used by citizen groups to increase the overall facility outreach to the community.

LEAN SIX SIGMA
FORENSICS
Laboratory process improvement designed by forensic scientists for forensic scientists.
DRAMATIC RESULTS*:
• 95% of cases completed within 30 days
• 214% increase in number of samples processed per month
• 505% increase in number of cases completed per month
*actual results achieved by Louisiana S.P.C.L.
DEFINE
MEASURE
ANALYZE
IMPROVE
CONTROL
6σ
Improvement projects can range from improving one specific process to improving an entire crime lab section (e.g. Toxicology, Latent Prints, DNA).
Projects range from 2 weeks (accelerated) to 24 weeks; specifically tailored to your lab.
Contact us:
801.462.1460
cgreen@sorensonforensics.com
Sorenson Forensics®

Bright

Both the Tucson and Johnson County projects incorporate a two-story atrium element where skylights and clerestory windows bring natural light into the central core of the building, penetrating down into the lower level. The laboratory spaces in both projects ring this central atrium space, allowing both interior and exterior windows in each laboratory to bring in as much natural light as possible. Perimeter exterior windows are provided with solar screens that project out above each window and provide much-needed shading from strong summer sunlight, while allowing the lower-elevation winter sun to penetrate further into the building when more solar gain is warranted. Each facility has a series of electronically-controlled sun shades on the inside of perimeter windows that protects from glare or direct sun conditions in working areas while still allowing ambient light to penetrate for illumination.

Figure 4: The Tucson Police Department Crime Laboratory was designed to coexist with its native desert environment. Courtesy of WSM Architects

An additional sustainable feature of both laboratories is the use of daylight sensors—when a room achieves adequate ambient light levels due to natural daylighting, ceiling fixtures will turn off in those areas to save energy and will automatically turn back on when daylight levels drop below the acceptable threshold. In the Johnson County Lab, additional lighting was desired in the screening rooms. In the past this has been handled by medical exam lighting, but the additional electrical load of these fixtures had a negative impact both on the power consumption and heat gain in the exam spaces. The solution was to use new, high-output LED fixtures that use a gridded array of LED lamps that produces an almost shadow-less and extremely bright, clean light onto exam surfaces.

Sexy

Sexy is an adjective not often assigned to forensic facilities. The nature of a public facility such as a forensic facility is one of utility—both by merit of the task at hand (serving the public) as well as by the scrutiny of public money for the construction of such facilities. However, utilitarian design does not have to be institutional. It can be playful, attractive, and yes, we've said it—SEXY. Both of the highlighted projects have that sex appeal, from two very different perspectives.

While the Tucson lab is white and clean, the Johnson County lab is warm and embracing. By merit of its white interior, the Tucson Police Department Crime Lab has much more in common with a museum than an institutional facility. The white walls offset laboratory themed artwork and highlight the colored entryways into each section. Segmented light fixtures that form a circle accent the circular clerestory ceiling element in the atrium. Even the practical tensile structures in the parking lot have excitement and movement while providing needed shade to cars from the harsh desert sun.

In the Johnson County Sheriff's Department Criminalistics Laboratory, the central stair and bookshelf element of Locard's Plaza are made of sustainable ipe wood—chosen not only for its beauty but for its practical durability for use in a feature stair. The patio area adjacent to the break room is located away from the public eye—a design feature that is again practical in nature, working with the site's topographical features and not against them.

At face-value, design for forensic science is practical. It provides a safe work environment for employees as well as a secure environment for evidence and sensitive materials. It is economic and budget-driven. But the new face of forensic science is more than that. It is sustainable. It is smart. It is beautiful. Donald Norman, an engineer, psychologist, and usability design expert has said it best, "Beauty and brains, pleasure and usability go hand-in-hand in good design."[1] We would agree.

References

1. Norman, Donald A. "Emotional Design" *Ubiquity Magazine*, 2004, January Issue, page 1.

Susan Halla *(susanh@crimelabdesign.com) and* ***Keith Whittle*** *(keithw@crimelabdesign.com) are Senior Forensic Planners leading projects from inception to completion for Crime Lab Design providing full architectural and engineering services for forensic and medical examiner facilities worldwide.*

Keith had the pleasure of working with WSM Architects (www.wsmarch.com) from Tucson, Arizona, on the Tucson Police Department Crime Laboratory project. Susan had the pleasure of working with PGAV Architects (www.pgav.com) from Westwood, Kansas, on the Johnson County Sheriff's Department Criminalistics Laboratory (and even met her new husband on the project). We would like to thank both firms for their insightful leadership and design acumen on these projects.

Rapid DNA is Here!

RapidHIT™

- ✔ DNA profile in <90 min
- ✔ Actionable information
- ✔ Where you need it

See the RapidHIT at:
Biometric CC — Booth 500
IACP — Booth 3801

Bruce Jamieson
RapidHIT Senior Director of Sales

integenX

For more info visit: www.integenx.com • 888 371 4749

Copyright © 2012 IntegenX Inc. All rights reserved. Patents pending. IntegenX and RapidHIT are trademarks of IntegenX Inc. All other brands and names are the sole property of their respective owners. Product specifications may change.

Easy Reporting of Hard DNA: Computer Comfort in the Courtroom

How can an analyst translate uncertain DNA data into understandable testimony for a non-expert jury?

Dr. Mark W. Perlin

Analyst Unplugged

A DNA analyst's life alternates between laboratory routine and courtroom unpredictability. In the lab, biological evidence is chemically separated into DNA data. Simple evidence (such as one man's blood on a knife) produces simple data, easily reported and explained in court. The greater complexity of today's low-level and mixed DNA introduces interpretation and courtroom complications, however. How can the analyst translate uncertain DNA data into understandable testimony for a non-expert jury? How well will evidence and analyst hold up under vigorous cross-examination?

The DNA match statistic is a powerful tool for taming DNA uncertainty. The statistic, or "likelihood ratio," summarizes in a single number the evidential support for a person having contributed DNA. With simple evidence from a single person, this ratio is easily explained:

- the numerator (upper half) is "1," the chance of a match if the prosecutor is correct, while
- the denominator (lower half) is the prevalence of the person's genotype in the population, i.e., the chance of a coincidental match when the prosecutor is mistaken.

Multiplication combines the statistics from all independent genetic loci. We can then read a one in quadrillion (a one followed by 15 zeros) genotype rarity as the understandable statement: "a match between evidence and suspect is a quadrillion times more probable than coincidence."

What about DNA mixtures? Alas, those are not so simple. The analyst must explain to a jury how a "threshold" classified data peaks into "alleles," but also that this threshold varies between laboratories and may give conflicting or inaccurate results. Scientific certainty devolves into subjective opinion, susceptible to cross-examination scrutiny. How can the analyst reestablish the comfort of single-source samples when testifying about mixtures in court? Without solid scientific assurance, forensic laboratory policy may discard informative crime-fighting DNA evidence as "inconclusive."

Fortunately, modern computing can help. An objective probabilistic computer can thoroughly examine the DNA mixture evidence, separating out the genotypes of each person who contributed. A separated contributor genotype can then be matched and explained with the ease and simplicity of single-source DNA. With this computer assistance, an analyst can confidently testify in court about objective scientific mixture results, without branding vital evidence "inconclusive."

Easy Reporting

Why is single-source short tandem repeat (STR) DNA so easy to interpret and explain? Because the genotype is immediately evident from the data (Figure 1). The biological specimen (e.g., a reference sample) has one true genotype at each STR locus. After the laboratory extracts, amplifies, and separates the DNA, a fluorescent data signal shows peaks that exactly correspond to this genotype. A single peak shows a homozygote allele pair (one allele repeated twice), while two peaks give a heterozygote pair of two different alleles. Data artifacts (PCR stutter, relative amplification, etc.) are minimal, so people or computers can easily infer the genotype's unique allele pair with high confidence. Sample, data, and inference may

be conceptually different, but they all share the same unambiguous genotype.

The single-source genotype has an obvious match statistic, the random match probability (RMP). As mentioned, the RMP ratio is one over the population probability of a randomly selected person. Inverting a small coincidental probability gives a large match statistic, expressing high evidential force that the match observed between evidence and suspect is not coincidence. In court, this easy DNA evidence encounters little resistance, and the analyst is entirely at ease describing data, genotype, and match.

Hard DNA

With low-level DNA or mixtures, the unambiguous correspondence between data and genotype breaks down. The data may now support more than one genotype possibility. With multiple allele pair possibilities for each contributor, the data is no longer self-evident or easy to explain in court. What is an analyst to do?

Often, an analyst will examine the data and declare the mixture to be "inconclusive." There may be informative STR peaks, but some fall below their lab's interpretation threshold, so those data are not used or reported on in a match statistic. Sometimes an analyst will valiantly struggle with a complex mixture, knowing in their heart that the data are informative. But after a weeklong engagement, they reluctantly call it off as "inconclusive," losing the DNA evidence.

A common mixture interpretation method is the combined probability of inclusion (CPI). CPI treats the set of peaks above a threshold as alleles donated by contributors. The validity of CPI has been questioned, since changing the threshold gives different answers, some of which are wrong. Moreover, CPI ignores important data (e.g., a known victim genotype, or the different heights of data peaks), and so loses considerable information, often greatly understating the true match statistic. In some cases, through non-optimal data use or biased knowledge of the suspect's genotype, CPI can overstate the evidence against a defendant.

Analysts sometimes undertake more informative mixture interpretation, such as combined likelihood ratio (CLR) on a two person mixture having a known contributor reference. These methods entail writing down allele pairs that explain the data. The assumed thresholds and human decisions are harder to explain to a jury and let an opposing attorney raise reasonable questions about the analyst's testimony.

How can the analyst objectively and thoroughly interpret DNA mixtures, preserving match information? What reliable mixture computer tools offer protection from a courtroom barrage of undermining cross-examination? As we next discuss, a computer can restore the ease and comfort of single-source evidence when analysts report on DNA mixtures in court.

Computer Comfort

With DNA mixtures (Figure 2), the genotype may not be evident from the STR data.

- A biological mixture specimen is a combination of two or more contributor genotypes. Each contributor's allele pair at a locus may be definite in reality, but is unknown to us.
- We generate laboratory data that reflects these constituent genotypes. The STR signals and their peaks are not genotypes—rather, they are data derived from the underlying genotypes.
- From the observed data, we (or our computers) can infer a genotype. We list the multiple allele pair possibilities, describing our relative belief in each one by a probability.

Human review tries to extend the simplicity of a single-source situation (Figure 1) to complex mixtures (Figure 2). The hope is to ascribe to DNA data the stature of genotype by applying thresholds to envision alleles. But data are not genotypes, and so the analogy breaks down. Instead, we must continue forward from the data, inferring genotypes, and capturing our uncer-

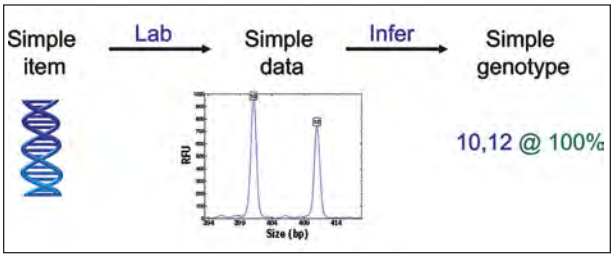


Figure 1: Single source genotype. A) In nature, the true genotype of an individual at a locus is some allele pair. B) Laboratory data casts the alleles of this genotype as peaks, where the peak's x-axis location designates the allele and the y-axis peak height indicates the DNA quantity. C) The individual's genotype is readily inferred from the data.

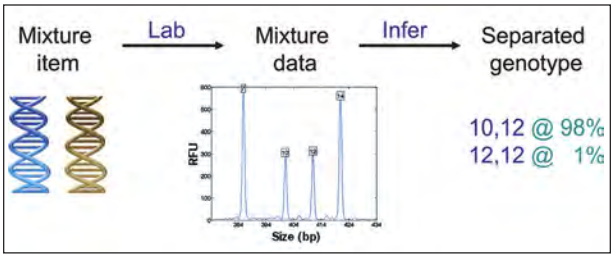


Figure 2: Mixture genotype. A) The unknown genotypes of the two (or more) contributors to the mixture are unknown to us. B) Laboratory data from this genotype generates peaks that suggest contributing alleles and their amounts. C) A contributor's genotype can be inferred from the mixture data.

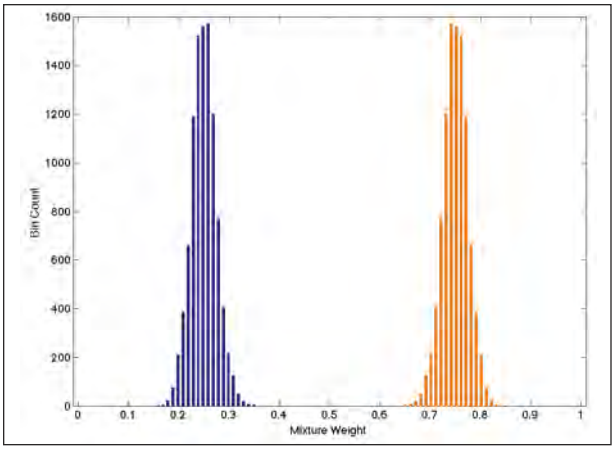


Figure 3: Mixture weight. The computer can separate a DNA mixture into its components, shown here as major (orange) and minor (blue) contributors. The center of each histogram bell curve is the average mixture weight of the contributor's DNA template, while the histogram's spread shows the mixture variation across locus experiments.

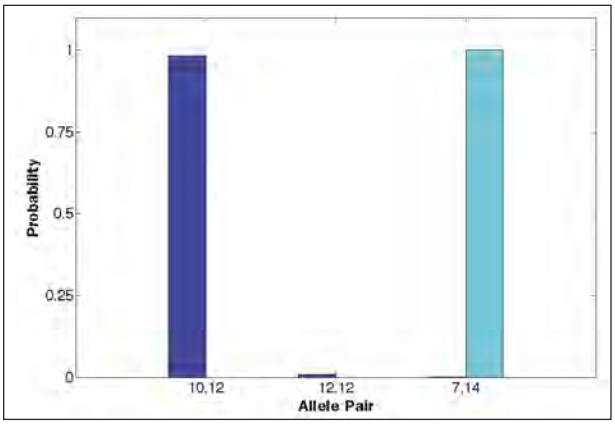


Figure 4: Separated genotypes. When the data permit, the computer can separate a mixture into essentially single source genotypes. The 3:1 ratio provides sufficient peak height differentiation between the two contributors to separate the mixture (shown at the Penta E locus) into major (light blue) and minor (dark blue) genotypes.

tainty through probability.

The computer does this mathematically by separating out mixture contributors, along with their genotypes. A two person mixture can be separated into major (Figure 3, orange) and minor (Figure 3, blue) contributors, each having a mixture weight (here 75% and 25% respectively, with a 5% uncertainty). A contributor's genotype at a locus is usually known only up to probability, but sometimes computer separation yields essentially single-source genotypes (Figure 4).

A comparison can be made between the inferred evidence (i.e., mixture contributor) genotype and a reference (e.g., suspect) genotype, relative to a population genotype. This match comparison is just like the easy RMP single-source framework, since it properly compares genotype with genotype. Importantly, all of the analyst's pictures, words, and intuition from a single contributor extend naturally to understanding and explaining DNA mixtures.

There is comfort in testifying about reliable computer mixture interpretation that has been:

1. Validated with both laboratory synthesized data and adjudicated cases
2. Published in peer-reviewed journals
3. Admitted as evidence after admissibility challenge
4. Accepted by trial and appellate courts and demonstrates proven sensitivity, specificity, and reproducibility.

The analyst can have confidence in an unbiased interpretation (no knowledge of the suspect's genotype) that thoroughly considered all feasible solutions.

Preparing for Court

A testifying analyst should be comfortable with the reliability of his or her conclusions. This comfort level can be achieved by examining replicate computer runs that were conducted on the same data. With concordant genotypes, the computer reproducibly concentrates probability onto the same allele pairs, as visualized in a series of similar looking probability bar charts (Figure 5).

The analyst prepares a DNA match report that describes the examined evidence, interpretation method, and match comparison results. A match between evidence item and reference is expressed numerically, with one statistic produced for each ethnic population considered. The match statement is written in plain language as: "a match between the evidence item and

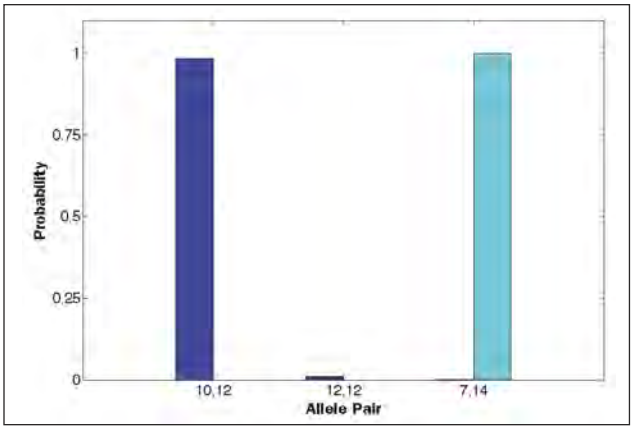


Figure 5: Concordant genotypes. Independent computer runs can establish the reproducibility of the computer's genotype determination, shown here in quadruplicate at the Penta E locus. Each independently inferred evidence genotype is shown in a different shade of blue, with probability concentrated on allele pair 10, 12.

Promega | Powered for 23 years

ISHI

INTERNATIONAL SYMPOSIUM ON HUMAN IDENTIFICATION

NASHVILLE, TN • OCT. 15–18, 2012

Forensics Amplified

Join more than 800 forensic scientists from around the globe to explore and discuss the latest research, technologies and ethical issues in forensic DNA today.

Submit your abstract now!

Oral abstract deadline is June 11th

To register, learn more or submit an abstract visit:

ishinews.com

the suspect is a quadrillion times more probable than coincidence." When there is no statistical support for a match (a statistic around 1 or smaller), the report should state this finding.

Before the trial, the testifying analyst reviews his or her report with the trial attorney, explaining the underlying science and results. When opposing counsel requests information, the analyst can meet with them and respond to their discovery request. For court, the analyst should prepare a short presentation (e.g., a PowerPoint with under ten slides) that explains the science and evidence. They should also bring a copy of the report and case folder, having on hand a summary of all computed match statistics.

Virginia v Michael Gardner

Michael Gardner, a respected lawyer in Arlington, VA, was accused in June 2011 by three young girls of having molested them when they stayed overnight at his Falls Church home for his daughter's tenth birthday celebrations. Consistent with the allegations of inappropriate touching, no semen or other intimate biological evidence was found. However, some of the girls' clothing was collected and analyzed for DNA by the state crime lab.

The inside crotch panel of one girl's underpants showed a two person DNA mixture. The analyst could not eliminate the girl or Mr. Gardner as contributors to this mixture but was unable to calculate a CPI match statistic. The lab therefore sent the STR data (.fsa files) to Cybergenetics in Pittsburgh, PA, to compute a match statistic using computer-based probabilistic genotyping.

The computer interpretation was entirely objective, having no knowledge of reference genotypes, and thoroughly considered a hundred thousand candidate solutions. The computer mathematically separated the mixture data into major and minor contributors. The separation was virtually complete, producing two definite genotypes. Each genotype had a single-source appearance, with probability heavily concentrated on just one allele pair (Figure 4). Multiple computer runs reliably inferred concordant genotypes (Figure 5).

Match comparisons were made between the inferred mixture genotypes and the available reference genotypes. As expected, a genotype (major contributor) from the underpants matched the girl who was wearing them. Because of the complete mixture separation, the 75% single-source appearing genotype gave an exact match, yielding a single-source level match statistic of 363 quadrillion. (All statistics here are computed relative to a Caucasian population, with a 1% co-ancestry theta adjustment.)

The minor contributor genotype from the underpants was compared with the references. The essentially complete mixture separation meant that comparison of this 25% genotype with any reference would either show a) a very high RMP-like single-source statistic establishing a definite match, or b) an equally strong match rejection. The computer found that a match between the underpants and Mr. Gardner was 20 quadrillion times more probable than coincidence.

Trial Testimony

The Gardner trial began on Monday, April 23, 2012. The three young girls each testified for about four hours that week, enduring long cross-examinations. The state DNA laboratory analyst presented the biological evidence. On Thursday morning, the author was sworn in to testify about the computer DNA match statistics.

In a short PowerPoint presentation, I first introduced the jury to STR genotypes and DNA evidence interpretation (Figure 2). I showed them a quantitative STR data signal (from the underpants at the Penta E locus), and explained how the computer separates DNA mixtures. Specifically, I described visually how the computer considers all possible genotype solutions, giving higher probability to proposed peak patterns that better explain the observed peak height data.

The computer had objectively inferred an evidence genotype (Figures 4 and 5), determined solely from the data, without any knowledge of the suspect's genotype. Using bar charts, I visually explained the DNA match statistic (Figure 6), comparing the probability of the evidence matching the suspect (numerator) with coincidence (denominator); this ratio was around 30 at the Penta E locus.

I showed a bar chart of the 15 independent locus match statistics (Figure 7). Multiplying these numbers

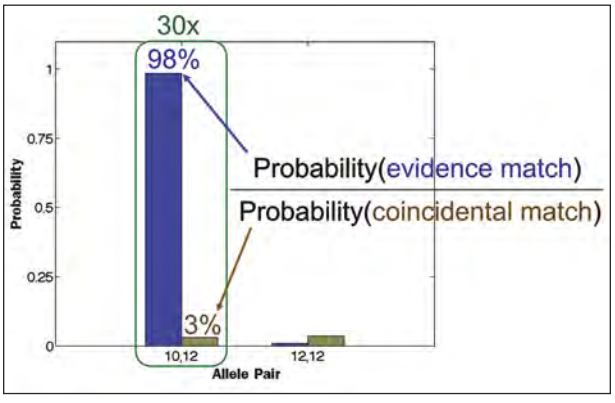


Figure 6: Locus match statistic. A DNA match statistic gives the probability of a match between the evidence and the suspect, relative to a coincidence. This ratio can be visualized at the suspect's genotype (green bar) as the relative heights of the evidence (blue bar) and population (brown bar) genotype probabilities. At the Penta E locus shown, this ratio of 98% (evidence) to 3% (population) at allele pair 10, 12 (suspect) gives a match statistic of around 30.

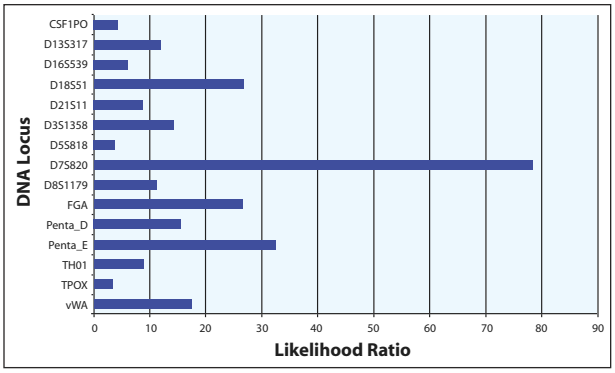


Figure 7: Match statistic. The bar chart shows the match statistics at all 15 loci. Multiplying these numbers together calculates the reported match statistic of 20 quadrillion.

together answered the question "Is the suspect in the evidence?" with the statement "A match between the underpants and Mr. Gardner is 20 quadrillion times more probable than coincidence."

The cross-examination took under an hour, never seriously challenging the reliability of the computer's DNA interpretation or its match findings. I explained why the 20 quadrillion DNA match statistic was scientifically expected.

The jury balanced Mr. Gardner's word against that of three fifth grade girls corroborated by DNA. On May 2, Michael Gardner was convicted of two counts of sexual battery and one count of object penetration. The jury sentenced him to 22 years in prison.

Analyst Reloaded

Forensic analysts currently testify about mixtures and other ambiguous DNA with justifiable trepidation. While their laboratory data are extremely reliable, the human interpretation of this data may lack rigor.

Much important DNA evidence, often crucial to a case or public safety, has been discarded by overly simplistic interpretation. Analysts often agonize over DNA mixtures, spending days wondering whether there is even a reportable match. Understating a statistic might free the guilty, while overstatement could wrongfully imprison an innocent man. Testifying can be stressful, with cross-examination questioning interpretation validity.

Interpreting DNA mixtures with a full statistical model, and hours of mathematical computing, can restore analyst confidence. Going into court with thorough and reliable match results and an understanding of computer interpretation establishes scientific comfort. The computer can separate out mixture data into component genotypes and represent uncertainty as probability, neither understating nor overstating the match statistic. A computationally empowered analyst assists the court through objectively derived fact, not subjective opinion.

Dr. Mark Perlin *is Chief Scientific and Executive Officer for Cybergenetics. He has twenty years experience developing computer methods for information-rich interpretation of DNA evidence and providing TrueAllele products and services to the criminal justice community. Cybergenetics, 160 North Craig Street, Suite 210, Pittsburgh, PA 15213; (412) 683-3004; perlin@cybgen.com; www.cybgen.com.*

how it works

Enabling Efficient Direct PCR Amplification for Swabs and Untreated Paper Samples

Problem: As forensic laboratories cope with an ever-increasing volume of DNA sample submissions, many wish to take advantage of direct PCR amplification for single source samples. Direct amplification allows laboratories to forego time consuming front-end processing steps including DNA extraction, purification, and quantification for reference standards and offender database samples. This provides obvious efficiency gains including significant cost and labor savings, and it increases quality assurance by reducing sample transfer steps resulting in fewer possibilities for sample mix-ups or pipetting errors. In addition, the simplified workflow makes it much easier and cheaper to automate liquid handling steps.

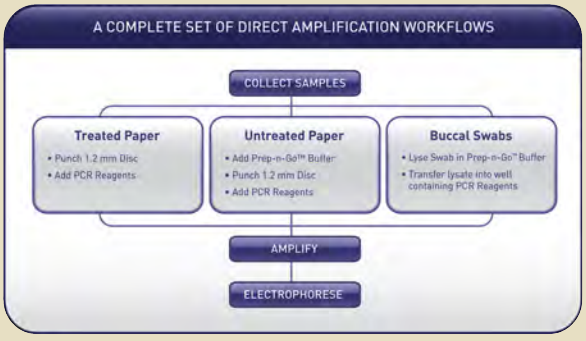
Life Technologies' Prep-n-Go Buffer

Until recently, however, this workflow option was only available to laboratories that process blood or buccal samples on chemically treated paper substrates. The chemicals impregnated in these substrates facilitate cell lysis for easy compatibility with direct PCR amplification, while deterring bacterial growth and the production of damaging nucleases for stable long term storage.

These are significant advantages; however, deposition of buccal cells onto impregnated cards requires transfer from a swab substrate, resulting in potential loss of biological material due to ineffective transfer. This is one reason, along with other factors such as cost and ease of use, why swabs and untreated filter paper collection devices are still widely used by many laboratories and jurisdictions. But these untreated substrates, because they don't enable built-in cell lysis, require multiple up-front processing steps to facilitate high quality direct PCR amplification, thereby eliminating the sought after efficiency and quality assurance benefits.

Solution: Life Technologies has developed the Prep-n-Go™ Buffer, which facilitates efficient cell lysis and high-quality results from swab and untreated paper substrates when used in conjunction with direct PCR amplification chemistries such as the Identifiler® Direct and NGM SElect™ Express PCR Amplification kits.

For untreated paper, the incorporation of Prep-n-Go Buffer requires only minor deviation from the direct amplification protocol for samples deposited on treated paper: 2 µl of Prep-n-Go Buffer is added prior to punching a disc from the untreated paper substrate into the well or tube and adding the PCR reagents. For swabs, a brief 20-minute incubation in 400 µl of Prep-n-Go Buffer is required prior to adding the lysate into the well or tube containing the PCR reagents. Depending on the PCR amplification kit being used and the type, condition, and age of the swab, the use of heat during the incubation step may be recommended.



During the development process, the Prep-n-Go Buffer underwent extensive internal validation testing as well as testing by external test site forensic laboratories. Results generated from the untreated filter paper-based Bode Buccal DNA Collector™ and three swab types including standard cotton swabs (Puritan®), flocked swabs (Copan 4N6FLOQSwabs™), and Whatman® OmniSwabs demonstrated high first pass success rates and data quality when tested in a direct amplification workflow using the Prep-n-Go Buffer. First pass success rates from buccal cells on swabs (N=398) and untreated paper (N= 582) were comparable to results obtained from direct amplification of blood and buccal cells on treated paper with greater than 97% of samples producing complete profiles at a 50 RFU threshold and greater than 94% producing complete profiles at a 150 RFU threshold. No artifacts were introduced by the use of Prep-n-Go Buffer.

Laboratories looking to improve upon their efficiency and quality assurance will benefit from the implementation of a direct amplification workflow incorporating Prep-n-Go Buffer. This solution enables the generation of high quality profiles from a wider range of sample types with a minimum of steps.

For more information, visit www.lifetechnologies.com/hid.

Forensic Phenotyping:
the 21st Century Composite Sketch

New methods are emerging which allow investigators to analyze crime scene DNA in order to accurately describe key physical traits of the source of the genetic material.

Tim Kupferschmid

With prime-time network television lineups dominated by programming about cops and lawyers, Americans have gained deep familiarity with two common elements of the justice system: the composite sketch used to nab the bad guy and the DNA test used to get the conviction.

These tools represent applications of two extremes of technology: one dating back to the advent of paper; the other among the foremost achievements of our generation. And yet few likely stop to consider this clunky juxtaposition, nor the fact that the same DNA used to place the perp at the scene of the crime contained the very genetic sequences used to code the face a sketch artist did her best to reproduce.

Indeed, in a universe free of the constraints imposed by money, time, or ethics, using an unknown perpetrator's DNA it is theoretically possible to create a clone which would, in several years, provide investigators with a physical description certain to be much more reliable than the best witnesses' recollections.

In the place of such a dystopian option, new methods are emerging which allow investigators to analyze crime scene DNA in order to accurately describe key physical traits of the source of the genetic material. Collectively known as DNA phenotyping, these technologies represent a key new development in the realm of forensics, to say nothing of the new warmth such tools promise to offer cold cases.

Most people understand that "genotype" refers to the actual sequences of 1.4-million nucleotides comprising the roughly 23,000 genes that make up an individual human's unique genetic fingerprint. Less well understood—by both the public and researchers—is the matter of "phenotype," which refers to how an individual's genes combine to express themselves in an observable way.

Gregor Mendel, the father of modern genetics and high school biology class staple, lucked out when he picked pea plants as subjects of the hybridization experimentations forming the basis of his foundational theories of inheritance, for peas have a simple genome that predictably expresses many phenotypes—notably those Mendel chose to study—in only one of two ways. Had Mendel picked more complex organisms, his breakthroughs likely would have proved elusive.

The challenge confronting forensic DNA researchers is the fact that unlike pea plants, humans are genetically complex organisms whose physical descriptions—which is to say, our phenotypes—are frequently influenced by multiple genes, many of which have yet to be identified. In other words, there is no single gene for most elements of outward appearance; instead, these and most other phenotypes are determined by many genes, which jointly operate in little-understood ways to produce the traits we use to identify one individual from another. Brown-eyed parents usually produce brown-eyed children not because they've passed on a single gene for brown eyes, but because they've passed on the same groups of genes that made the parents' own eyes brown.

While both obviously look for meaningful data in the subject's DNA, forensic phenotyping takes a markedly distinct approach from that of the DNA fingerprinting used in courtrooms. That's because DNA fingerprinting seeks to determine the relatedness of two samples by examining variations in Short Tandem Repeat (STR) sequences of the human genome that are present in us all but do not actually code for

anything, while forensic DNA phenotyping looks for variations in segments known to substantially influence externally visible traits.

The FBI's Combined DNA Index System (CODIS) acts as a central database of the many DNA profiles generated by crime labs on the municipal, state, and federal levels. These profiles associate known identities with 13 STR sequences, which the laws of probability confirm cannot possibly be the same in any two humans on the earth today—apart from identical twins. When a crime is committed and genetic material left at the scene is recovered, a DNA profile is created based on the subject's STR sequences. This profile is then compared with those on file at CODIS. Should that effort fail to produce a match, law enforcement is increasingly examining the same DNA for forensic phenotype insights able to help focus the investigation.

Early advances in forensic DNA phenotyping sought to take advantage of the human genome's low-hanging fruit, such as the subject's gender and whether or not he or she has red hair and freckled skin—the former being determined by the presence of an entire chromosome and the latter by a single recessive gene. These phenotypes can both be ascertained through simple tests, though the practical insights they yield usually prove to be of limited value to investigators.

Another round of progress in forensic DNA phenotyping was seen recently with the development of the IrisPlex test, which analyzes six genes to arrive at a prediction of eye color that proves 94% accurate. Tests for hair color and skin tone are also in various stages of development and use.

The shortcoming of these advances is the ease with which they are masked. Hair color predictions can be thwarted by dyes or the graying effects of age, while skin tone can be influenced by cosmetics and exposure to ultraviolet radiation. A physician in California recently announced that he can use lasers to turn brown eyes blue. Furthermore, the IrisPlex eye color test is only considered reliable when carried out on European populations.

More recently, Sorenson Forensics, where I serve as executive director, released a test able to predict an individual's genetic ancestry. This potentially allows investigators to eliminate large segments of the population from consideration and thereby work more efficiently.

The process of predicting one's genetic ancestry through DNA analysis is an interesting one and deserves some explanation.

There are no genes that code for ethnicity. While members of some ethnic groups can be recognized by a shared set of phenotypes, this knowledge is of no use to geneticists, who find classifications such as "race" to be arbitrary and without scientific foundation. That said, members within ethnic groups do tend to share at least one objective and genetically meaningful attribute: geographic ancestry.

In the full scope of human history, the ability to travel and reproduce far from the land of one's birth is a fairly recent one, meaning individuals sharing a common ethnic identity today tend to be descendants of groups that remained confined, geographically, for many centuries due to the lack of other options. Over time, portions of the collective DNA of human populations inhabiting geographically isolated regions became slightly distinct from that of human populations in other regions.

The legacy of this phenomenon is a series of what are called Ancestry Informative Markers (AIMs), which individuals carry with them today, whether or not they were born in their ancestral homeland. Consequently, analysis of the AIMs found in a sample of DNA permits highly accurate predictions of the sample source's relationship with five reference populations: Western European, Western Sub-Saharan African, East Asian, Indigenous American, and residents of the Indian Subcontinent. Through statistical analysis and an understanding of more contemporary human migration histories, it is possible to fill in the ancestral gaps not explicitly covered by these five groups.

For example, individuals whose ancestors hail from

FM1208
BAG YOUR EVIDENCE IN A WHIRL-PAK®
Contact us for your free catalog and sample!
USED BY THE FBI, DEA, US MILITARY AND OTHER LAW ENFORCEMENT AGENCIES.
Scan the code with your smartphone for more info
CRIME SCENE
• Strong clear polyethylene for maximum strength and visibility
WHIRL-PAK +1 Sterilization for contamination free storage
• Leakproof for liquids or solids
USA: 1-800-558-9595
Whirl-Pak.com • info@eNasco.com
Canada: 1-800-668-0600 • web: www.spectrumed.com

Latin America are generally the product of interbreeding of Indigenous American and Western Europeans dating back to the 16th Century's age of exploration. African Americans possess predictable ratios of West African and Western European AIMs, while Middle-Easterners can be identified by their mix of Western European, Indian Subcontinent, and West African AIMs.

In this way, AIMs of just five reference populations combine to include many more, akin to the way specific ratios of red, yellow, and blue combine to produce all other colors.

Discovery of these AIMs was made possible in part by analysis of the international HapMap project, which is an effort to find common patterns of genetic variation across geographic populations. Of the more than three-million single nucleotide polymorphisms documented by the HapMap project, we found 190 that can be reliably linked to genetic ancestry and used to predict that of unknown subjects.

Armed with these data and insights, Sorenson Forensics recently released a tool called Investigative Law Enforcement Ancestry DNA test (Investigative LEAD), giving cops a new tool for use in establishing the identity of unknown perpetrators, as well as that of victims whose remains have experienced significant degradation.

So far, the law enforcement community has greeted Investigative LEAD, IrisPlex, and other early forensic DNA phenotyping tools positively and with good results, though as with any disruptive new technology, some have their concerns, particularly with regard to privacy. The Netherlands, for example, passed laws outlawing DNA phenotyping, while Wyoming, Rhode Island, and Indiana have banned certain applications of it.

By all indications, in the U.S. the privacy question appears to be resolving itself such that support will remain in place for DNA phenotyping of outwardly observable traits, while more private ones, such as susceptibility to disease, tendency toward certain behaviors, and personal preferences will be off-limits as the ability to coax these characteristics from the genome emerge. Fortunately, this leaves substantial room for the continued nurturing and growth of the forensic DNA phenotyping space.

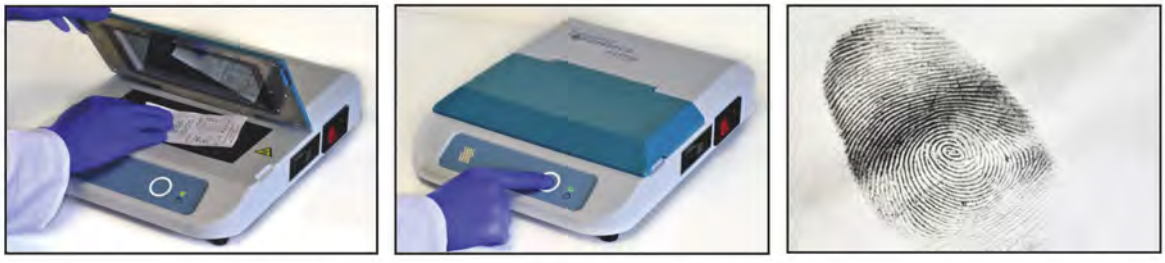
Investigators should be optimistic about the impact revolutionary new methods of forensic DNA phenotyping offer their field, as the paper and pencil-based composite sketch finally makes its way into the 21st Century.

Executive Director of Sorenson Forensics, ***Timothy Kupferschmid*** *has more than 20 years of forensic DNA testing experience.*

CONSOLITE® FORENSICS Ltd PRESENTS

HOT PRINT SYSTEM (HPS)

1 2 3



PRINTS FROM THERMAL PAPER IN UNDER 3 MINUTES

TIME SAVED FOR YOUR NEXT CASE

WWW.CONSOLITE.CO.UK

the Safety guys

Vince McLeod, CIH

Lucy in the Lab with Diamonds

We all know how diamonds are formed. You take a lump of carbon and subject it to intense pressure and high temperatures and magically those carbon atoms are pressed into a diamond. The diamonds we are going to form will be a tad easier.

This month's safety column is the third in our series on safe laboratory chemical management. Readers of our Safety Guys column were introduced to safe chemical handling with our "Planning Chemical Management for the Forensic Laboratory" article describing how to develop and implement a program for proper management of laboratory chemicals.[1] As that article stated, it all begins with a complete, up to date, and accurate chemical inventory. Our second article "Making Sense of MSDS" was a tutorial on understanding material safety data sheets.[2] This issue we are going to discuss the National Fire Protection Association (NFPA) hazard diamond, sometimes referred to as the fire diamond, and how to decipher the information it contains.[3]

Classes and the NFPA Hazard Diamond

Experienced laboratory managers know that there are four basic categories of chemicals: toxic, corrosive, flammable, and reactive. However, in our chemical world there are many additional categories and subsets of these main four. We should also keep in mind that many chemicals exhibit a combination of properties and would fall into more than a single class or category. These four properties are the foundation of the NFPA hazard diamond. Coincidentally, these four categories are the main criteria used to define wastes as hazardous under the federal Resource Conservation and Recovery Act (RCRA). The hazard diamond has gained wide acceptance and most manufacturers include it on their labels when appropriate. Figure 1 shows the layout of the different sections and our discussion will start at the top and work clockwise around the diamond.

◆ Flammability

The top of the diamond indicates the flammability hazard. The chemical is rated from zero to four. A zero means the material will not burn under most common circumstances. Examples include hydrogen peroxide and sodium hydroxide. A one indicates the material will ignite and burn at temperatures greater than 200°F. Materials that fall into this category are glycerine and propylene glycol. A two indicates substances that will burn at temperatures less than 200°F like naphthalene, octyl alcohol, and nitrobenzene. A rating of three denotes materials with flashpoints below 100°F such as xylene, amyl acetate, and butyl alcohol. Finally, a four indicates extremely flammable substances. These are things like acetone, ethyl ether, acetylene, and cyclohexane.

Figure 1: NFPA Hazard Diamond

Flammability may be the single most hazardous characteristic causing more injuries and damage than any of the others in the diamond. If there is anything other than a zero in this part of the diamond make sure to use this material with adequate ventilation, clean up spills immediately, and above all, keep heat and flame well away from the area of use.

◆ Reactivity

Moving clockwise, as promised, the next part of the hazard diamond designates the potential reactivity of the material, which is also rated from zero to four. Zero indicates a stable chemical under most conditions, even fire. Substances that are normally stable but can become unstable when heated or may react with water, but not violently, are rated a one. Chemicals that are rated a two are normally unstable and readily undergo violent decomposition. They may also react violently with water. Materials with a rating of three are capable of an explosive reaction or detonation if subjected to a strong initiating source such as heat or shock. A four indicates substances that are readily capable of explosive decomposition or detonation at normal temperatures.

For illustration of the reactivity, consider the following examples. Liquid nitrogen would receive a zero rating. It is stable, non-flammable, and non-reactive with water. Phosphorus (red or white) is rated a one since it

can become unstable at elevated temperatures. Calcium metal rates a two. Less reactive than sodium, it reacts violently with water, alcohols, and other materials and burns in air. Fluorine gas is an example of reactive material rating a three. It is the most reactive non-metal, decomposes in water producing hydrofluoric acid and other hazardous compounds, and reacts vigorously with most oxidizable substances at room temperature, usually with ignition. An example of a class four reactive substance is trinitrotoluene or TNT. We are all familiar with its explosive properties.

Special Hazards

At the bottom of the diamond is the white section. This section is used to denote special hazards. *NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response*, mentions only two approved symbols:

OX	This denotes an oxidizer, a chemical which can greatly increase the rate of combustion or fire.
	This means the substance is incompatible with water. It indicates a potential hazard using water to fight a fire involving this material.

Some organizations and manufacturers use additional symbols to indicate hazards associated with the substance. Examples of a few of these are presented below.

ACID	This indicates that the material is an acid, a corrosive material that has a pH lower than 7.0
COR	This denotes a material that is corrosive (it could be either an acid or a base).
	This is another symbol used for corrosive.
	The skull and crossbones are used to denote a poison or highly toxic material. See also: CHIP Danger symbols.
	The international symbol for radioactivity is used to denote radioactive hazards; radioactive materials are extremely hazardous when inhaled.
	Indicates an explosive material. This symbol is somewhat redundant because explosives are easily recognized by their Instability Rating.

◆ Health

The final section of the diamond is the blue section on the left hand side. This area denotes the health hazard of the compound and is also rated from zero to four. A zero indicates no toxicity and no additional hazard beyond normal combustible materials under condition of fire. A one means the material is slightly toxic and usually considered innocuous when used responsibly. It may cause some irritation, but only minor even without treatment. Moderately toxic materials are rated a two and may cause temporary incapacitation or injury with continued exposure unless medical treatment is given. A rating of three indicates a serious toxic material that can cause injury upon short exposures even if medical attention is given. Deadly or extremely toxic materials rate a four. Very short exposures could result in death or serious injury even with medical treatment.

I know you would be disappointed if I did not provide examples for the different health hazards as I have done for the flammables and reactives so here goes. Peanut oil is an example of a material that would rate a zero on the health scale. Turpentine would rate a one being irritating to skin and mucous membranes. Ammonia gas would rate a two since it is definitely irritating and corrosive, but generally regarded as nonflammable unless mixed just right in air. Also, ammonia has an exposure limit of 50 ppm and is immediately dangerous to life and health (IDLH) at 300 ppm. Extremely corrosive chlorine gas ranks a three for health hazard. It can form explosive mixtures and cause fatal pulmonary edema. The OSHA permissible exposure limit (PEL) is 1 ppm and the IDLH limit is only 10 ppm. An example of a health hazard four substance is arsine gas. A colorless gas with a mild garlic odor, it is extremely poisonous. For comparison, the OSHA PEL is a diminutive 0.05 ppm and arsine is IDLH at only 3 ppm.[4]

Now you understand diamonds, those that provide colorful gems of knowledge. Be on the lookout for them and pay attention to what they are telling you. As Sergeant Esterhaus from Hill Street Blues says, "Let's be careful out there."

References

References can be found online at www.forensicmag.com/article/lucy-lab-diamonds.

Vince McLeod *is an American Board of Industrial Hygiene Certified Industrial Hygienist and the senior IH with the University of Florida's Environmental Health and Safety Division. He has 24 years of experience in all facets of occupational health and safety and specializes in conducting exposure assessments and health hazard evaluations.*

John J. Barbara

Windows 7 Registry Forensics: Part 6

Registry Forensics—Attached Devices

Registry Keys track each mounted volume and assigned drive letter used by the NTFS file system. Information concerning any external devices (such as USB devices, CD/DVD ROMs, external memory cards, digital cameras, etc.) that had previously been attached to the system will be recorded in certain Registry Keys. On a live system, "regedit" or "Registry Commander" can be run from a USB device to access these Keys. The Keys can be exported directly from a live system and saved as readable text files.

1. MOUNTED DEVICES and STORAGE DEVICES:

• *HKLM\SYSTEM\CurrentControlSet\Enum\USB*

The Subkeys are the serial numbers of devices that have been attached to the system. Each of the Subkeys will record the most recent time a USB device was attached and will also provide the date and time that the device was originally attached to the system. For example, the serial number of the Patriot USB device mentioned in the previous column was "093A17A322A6." Searching for that value provided the following data:

"VID_13FE&PID_1F00"
"Last Write Time: 7/14/2010 - 12:49 PM"

"VID_13FE&PID_1F00\093A17A322A6" Subkeys respectively:
"Last Write Time: 2/19/2012 - 11:55 AM"

"VID_13FE&PID_1F00" is a class identifier. Each of the entries in the Key is specific to a particular make and model of USB device. The "Last Write Time: 7/14/2010 - 12:49 PM" represents the first time that the device was attached to the system. This date does not change when the same device is repeatedly reinserted. The second "Last Write Time: 2/19/2012 - 11:55 AM" represents the last time that the same device was attached to the system and corresponds to the same "Last Write Time" found in the "HKLM\SYSTEM\CurrentControlSet\Control\DeviceClasses\" Subkey "{53f56307-b6bf-11d0-94f2-00a0c91efb8b}" (which was also identified in the data described previously in *"HKLM\SYSTEM\MountedDevices" Key)*.

• *HKLM\SYSTEM\CurrentControlSet\Enum\USBSTOR*

Whenever any device is connected to a USB port, drivers are queried and a Subkey, which includes the device's name, is created under this Key. Another Subkey consisting of the serial number of the device is also created. (If the second character is an "&" it is indicative that the device does not have a serial number). The first and last times that each device was attached are also recorded in each Subkey. Searching for the Patriot USB device previously described provided the following data:

"Disk&Ven_&Prod_Patriot_Memory&Rev_PMAP"
"Last Write Time: 7/14/2010 - 12:49 PM"

"Disk&Ven_&Prod_Patriot_Memory&Rev_PMAP\093A17A322A6"
"Last Write Time: 2/19/2012 - 11:55 AM"

These "Last Write Times" are analogous to those discussed above. On a live system, a tool such as "USB-Deview" can be used to parse out all the USB storage device information.

• U3 ENABLED DEVICES

In addition to serving as storage devices, many USB devices can be configured to be used as portable desktops. They include applications that run when the device is attached to a computer. To a host system, U3 devices appear as USB Hubs with attached CD drives and USB storage devices. Windows normally will show two drives, a read only volume on an emulated CD-ROM drive and a regular FAT formatted USB drive. The emulated CD-ROM drive contains an Autorun configuration which launches the U3 LaunchPad. Normally, there is a hidden system folder stored in a CDFS partition on the USB drive that contains the applications. The "HKLM\SYSTEM\CurrentControlSet\Enum\USBSTOR\" Key lists U3 device(s) by their device Class ID, similar to the following:

"Disk&Ven_SanDisk&Prod_U3_Cruzer_Micro&Rev_2.18"

• USB SUMMARY

It is not easy for someone to obfuscate the fact that a particular USB device had been attached to a system. Using the "Registry Commander" tool, a search on a live system for the serial number of the previously mentioned Patriot USB device produced a total of 71 hits under 17 different Keys:

• HKLM\SOFTWARE\Microsoft\WindowsNT\CurrentVersion\EMDMgmt\
• HKLM\SOFTWARE\Microsoft\Windows Portable Devices\

Devices\
• HKLM\SYSTEM\ControlSet001\Control\DeviceClasses\
• HKLM\SYSTEM\ControlSet001\Enum\STORAGE\Volume\
• HKLM\SYSTEM\ControlSet001\Enum\USB\VID_111D&PID_0000\
• HKLM\SYSTEM\ControlSet001\Enum\USBSTOR\
• HKLM\SYSTEM\ControlSet001\Enum\WpdBusEnumRoot\UMB\
• HKLM\SYSTEM\ControlSet002\Control\DeviceClasses\
• HKLM\SYSTEM\ControlSet002\Enum\STORAGE\Volume\
• HKLM\SYSTEM\ControlSet002\Enum\USB\VID_111D&PID_0000
• HKLM\SYSTEM\ControlSet002\Enum\USBSTOR\
• HKLM\SYSTEM\ControlSet002\Enum\WpdBusEnumRoot\UMB\
• HKLM\SYSTEM\CurrentControlSet\Control\DeviceClasses\
• HKLM\SYSTEM\CurrentControlSet\Enum\STORAGE\Volume\
• HKLM\SYSTEM\CurrentControlSet\Enum\USB\VID_111D&PID_0000\
• HKLM\SYSTEM\CurrentControlSet\Enum\USBSTOR\
• HKLM\SYSTEM\ CurrentControlSet\Enum\WpdBusEnumRoot\UMB

2. SYSTEM PRESENCE of USB DEVICES

• HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\WindowsNT\ CurrentVersion\Tracing\Microsoft\PlugPlay\SETUPAPI
• HKEY_LOCAL_MACHINE\SYSTEM\ControlSet001\Control\Session Manager\KnownDLLs
• HKEY_LOCAL_MACHINE\SYSTEM\ControlSet002\Control\Session Manager\KnownDLLs
• HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\KnownDLLs

These four keys appear to control the "setupapi.dll" file which may determine whether or not logging will occur. The file is located in the "C:\Windows\System32" directory and contains functions used by installation and setup programs. It serves as a dynamic link library controlling the setup, installation, removal, and maintenance of applications and is required for Windows to operate correctly. Specifically, this includes installing and queuing files, logging of files as they are installed, updating the Registry, notifying the user of any installation errors, starting or restarting the computer, copying files, and accessing the routines that control device installation. All of these activities are logged.

•"setupapi.dev" FILE

This file is located in the "C:\Windows\inf\" directory and is text-readable and forensically important. It is essentially a device installation log. Whenever a removable storage device is connected to a computer for the first time, the Plug and Play Manager makes note of the new device's presence, queries the device for identifying information, creates a class identifier for the device, and locates the appropriate device driver. This information is recorded in the log file. For instance, when the Patriot USB device previously mentioned was connected to a USB port for the first time, the Plug and Play Manager received an event notification, queried the device to develop a class identifier, and attempted to find an appropriate driver:

"[Device Install (Hardware initiated) - USBSTOR\Disk&Ven_&Prod_Patriot_Memory&Rev_PMAP\093A17A322A6]
Section start 2010/07/14 12:49:37.659"

Information from the file provided the device serial number (093A17A322A6) and the date and time the device was first attached (2010/07/14 12:49). A Key was also created under "HKLM\SYSTEM\CurrentControlSet\Enum\USBSTOR\" which used the device Class ID "Disk&Ven_&Prod_Patriot_Memory&Rev_PMAP." Under this Key another Key was created which used the serial number of the device. A unique system generated identifier would have been created if the device did not have a serial number.

John J. Barbara *owns Digital Forensics Consulting, LLC, providing consulting services for companies and laboratories seeking digital forensics accreditation. jjb@digforcon.com*

Advertiser Index

ASCLD/LAB 19
Bruker Optics 5
Cayman Chemical Company Inc. 17
Cellebrite USA Corp 3
Champlain College 20
Consolite Forensics Ltd 41
Cybergenetics 16
Forensics Source 23
GE Healthcare Bio-Sciences 11
Hamilton Robotics 47
IntegenX Inc 31
Life Technologies 48
Nasco Science 40
Niche Vision 21
NuAire Inc. 7
Promega Corporation 13, 35
Sorenson Forensics 29
SPEX Sample Prep LLC 37
Streck Inc 27
The Bode Technology Group 9
The Evidence Conference 24-25
Thermo Fisher Scientific - Scientific Instrumentat 15
University of Florida Forensic Program 2

Dick Warrington

Arson: Crime Scene Processing Basics

Some of the most challenging scenes to process involve suspected arson. Such scenes call for the special expertise of an arson investigator. But the CSO is still responsible for collecting general evidence at the scene and also provides valuable assistance to the arson investigator. And by working with the arson investigator, you gain valuable knowledge that will aid you in future cases.

If you arrive at a scene and suspect arson, immediately call in an arson investigator. The fire department or state fire marshal's office has specialists who can investigate the cause of the fire. If it's arson, they can process the scene. Don't hesitate to call in these experts. I had a scene at a rural house that I thought was arson. I could see four points in the basement where the fire started. What I didn't know was that the house used propane; when propane ignites, it stays low to the ground. In this case, an accidental spark had ignited the propane, causing the fire. Without the arson investigator's help, I wouldn't have had an accurate picture of what had happened. If an arson investigator isn't available, do your best with the knowledge you have to document and process the scene thoroughly.

Before you begin processing the scene, secure the perimeter and limit access as much as possible. Don't think of the crime scene as just the building or the car where the fire occurred. Consider a broader area. An empty gas can or other evidence may have been pitched in the surrounding bushes or fields.

Remember, safety first! If you find an explosive device, back out and call the bomb squad. Be alert to dangerous areas of the building. If there are burn victims present, get them help immediately. The victims may have evidence on them, so remember to collect their clothing and other items once they receive help.

Thoroughly documenting the scene is essential. Keep an accurate log of who enters and leaves the scene. Photograph the entire scene from different angles before you process it and create diagrams. When you begin collecting evidence, photograph each item where you find it. Note the location, the date, and the time. Remember that maintaining a proper chain of evidence is crucial. When you go to court, you can bet the defense will ask you where the evidence came from and who was responsible for it.

Another essential step is taking proper precautions to ensure the scene isn't contaminated and you're protected. Arson scenes may be especially hazardous because of the possible presence of toxic fumes, smoke, and dangerous debris. Always wear gloves and appropriate foot coverings. In some cases, you may need a mask and/or breathing apparatus. If there is a body at the scene, wear a protective Tyvek suit to protect against health hazards from blood or other bodily fluids. Note that in arson cases, you should wait to call the coroner until the arson investigator has finished his work around the body. You want to be sure the area around the body is well documented and that you have retrieved all evidence on and near the body before it's moved.

When you're ready to begin processing, proceed like it's any other scene: find and collect any evidence that could possibly be relevant. Follow the basics and look for fingerprints, latent prints, tire tracks, foot prints, impression evidence, hair, fibers, blood, and other body fluids. Also look for items such as tape, fabric/material, cigarettes, drugs, glass, wood, soil, documents, mail, computers, answering machines, firearms and other weapons, paints, any of the victims' personal items.

Some items can't be processed because of damage from the fire or from efforts to contain it. In some cases, though, fingerprints will be visible because of the soot. Be observant. Oil residue and water don't mix; you may find more prints than you'd expect if you search carefully. In arson cases you're also looking for evidence of an accelerant.

Evidence collected from the scene must be placed in proper containers. Items that may contain an accelerant must be placed in arson containers or new metal paint cans with lids that trap vapors. Once the items are sealed in the containers, label them. Don't use plastic for accelerants—the vapors will leach out of the plastic and the lab won't be able to determine the type of accelerant from the material.

Put wet items (clothing or other items with blood, semen, etc.) in butcher paper, then place them in an open plastic bag until you return to your office. Let the items air dry before labeling and sending them to the lab. If you don't allow them to dry, they'll become moldy and you won't be able to use them.

Working an arson scene can seem daunting. Besides all of the usual challenges, you have to deal with the damage caused by the fire itself. In some cases, you may have to sift through huge piles of debris just to get to the point where the fire started. Collecting and processing evidence in these situations requires patience and persistence.

Dick Warrington *is in research and development and a crime scene consultant and training instructor for the Lynn Peavey Company, dwarrington@peaveycorp.com.*

Streamline *your* workflow

Automated Forensic Solutions

Time To Rethink

easyPunch STARlet

Automated FTA card punching and subsequent liquid handling

- FTA card punching & subsequent liquid handling
- User friendly software
- Superior card imaging & analysis

AutoLys STAR

Unique automation workstation for sample lysis and extraction

- Complete automation for sample lysis and DNA extraction
- A variety of forensic sample types
- On deck integration of third party equipment

ID STARlet

Fully automated workstation for forensic samples

- Complete forensic workstation with Life Technologies
- Automated genetic identity sample processing
- DNA extraction, quantification, normalization & STR profiling

Why Hamilton?

- Development of new generation dedicated solutions for forensic DNA analysis.
- Able to address daily sample processing needs and relieve backlogs
- Expertise for both casework and reference sample processing across large customer base
- Dedicated support and applications personnel

Hamilton Robotics – providing innovative and fully automated forensic solutions

HAMILTON

Contact 800.648.5950

Reno, NV | www.HamiltonRobotics.com | marketingrequest@hamiltoncompany.com

When people are counting on you, you need a partner you can count on

Only Life Technologies can provide a fully validated forensic DNA workflow where each component—reagent kit, instrument, and software—is manufactured and tested according to rigorous quality standards to create a reliable, accurate, and integrated analysis solution. Our systems are backed by the most extensive global network of training and support to enable peak lab performance—because your success matters.

To purchase reagents and instruments, go to
lifetechnologies.com/hid

life technologies™

For Research Use Only. Not intended for any animal or human therapeutic or diagnostic use. © 2012 Life Technologies Corporation. All rights reserved. The trademarks mentioned herein are the property of Life Technologies Corporation or their respective owners.